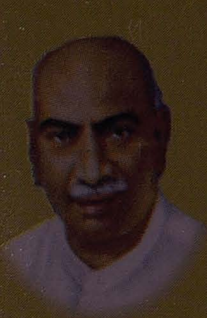


MADURAI KAMARAJ UNIVERSITY

(University with Potential for Excellence)





B.Sc.

ZOOLOGY

First Year

Invertebrata & Chordata

(Practical I)

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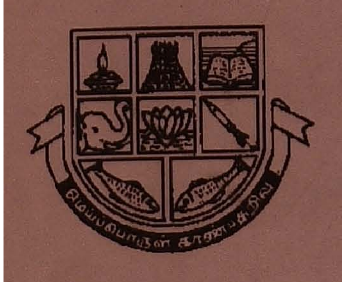
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This reading material, developed by **Dr (Mr).C. Kandeepan & Mrs. R.V. Kalaimathi**, Arulmigu Palaniandavar College of Arts & Culture,Palani and **Mr. Ga. Bagavathiappan & Mrs, M.Vanitha** S.B.KCollege, Arupukottai. reviewed by **Dr. (Mrs) I. Isabel**, P.G. Professor & Head, Lady Doak College, Madurai & **Mrs. Raja Rajeswari, Associate Professor & Head**, G.T.N Arts College, Dindigul is an aid for the students of Directorate of Distance Education, Madurai Kamaraj University, to understand the course content. It is only for the registered students of DDE, MKU and is not for private circulation.

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Paper - III Practical I — Invertebrata and Chordata

Invertebrata

Dissection Charts:-

1. Earthworm: Nervous system.

2. Cockroach: - Digestive system and Nervous system,

3. Pila: -Digestive system

4. Frog: - Arterial system

5. Calotes: - Venous system

Mounting Charts

1. Earth worm – Body setae
2. Cockroach – Trachea
3. Honey Bee – Mouth parts and Sting
4. Pila – Radula
5. Shark –Placoid scales
6. Frog – Brain

Spotters:

1. Protozoa- amoeba, paramecium, paramecium conjugation, euglena
2. Porifera – simple sponge, gemmule, spicules
3. Colenterata – obelia colony, medusa of obelia, sea anemone, any two corals,
4. Helminthes- liver fluke, redia larva, cercaria larva, ascaris male and female
5. Annelida – earthworm, nereis, hetero nereis, leech
6. Arthropoda – prawn, zoea larva, mysis larva, peripatus, honey bee and silk worm
7. Mollusca - pila, sepia, octopus, pearl oyster,
8. Echinodermata – starch fish, sea-urchin, sea-cucumber, bipinnaria larva

Chordata

1. Prochordata – Amphioxus, Balanoglossus, Asidian.
2. Agnatha – Pertomyzon
3. Pisces –tilapia, eel, hippocampus, narcine, echeneis
4. Amphibian – Bufo, salamander, ichthiopis, rhacophorus
5. Reptilia - Cobra, Krait, Viper, Dryophis, Ptyas, Chamaeleon, Drogo
6. Birds – Pigeon, Archaeopteryx
7. Mammal – Bat, Rat.

PRACTICAL

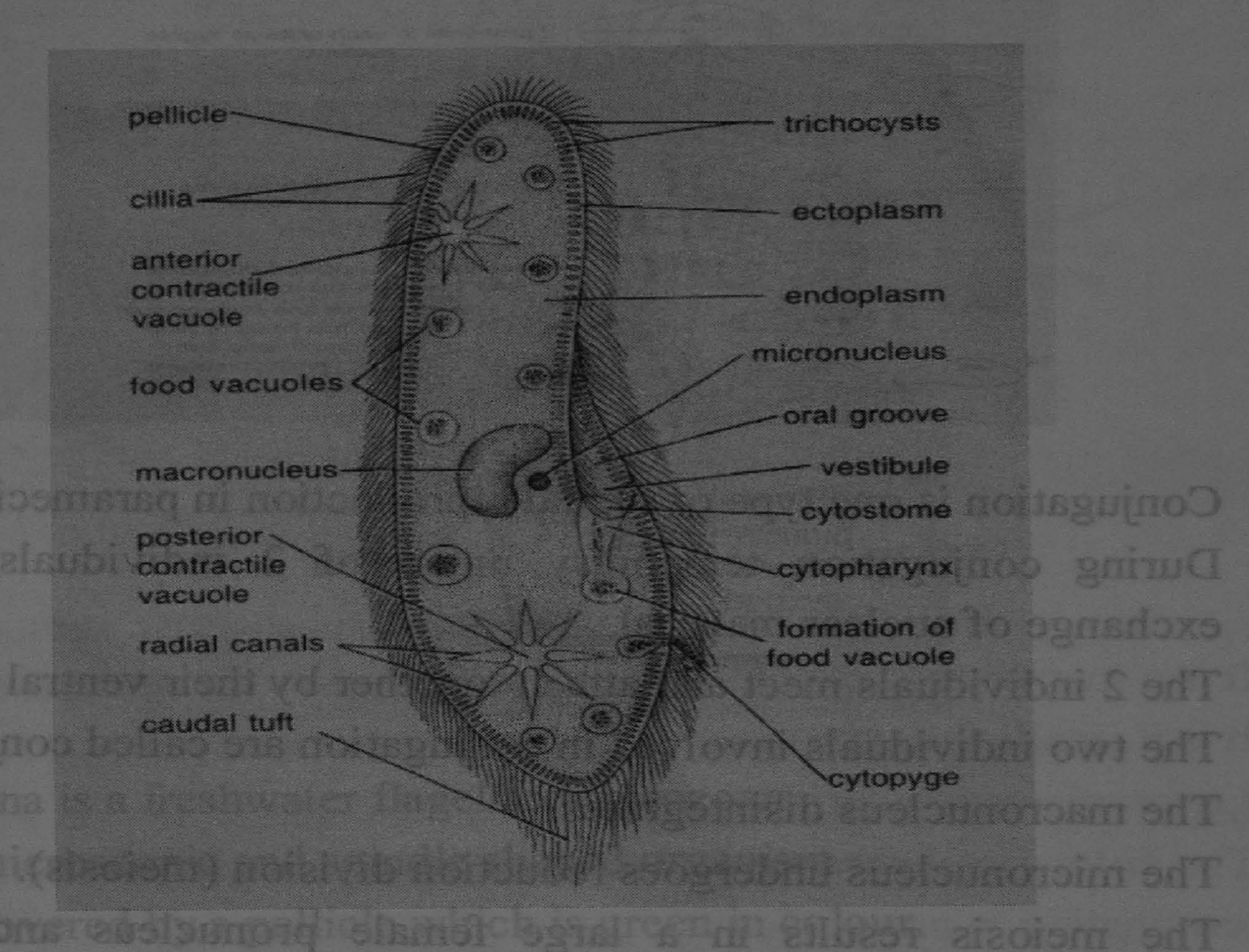
1.PROTOZOA PARAMECIUM – ENTIRE

Phylum : Protozoa

Class : Ciliophora

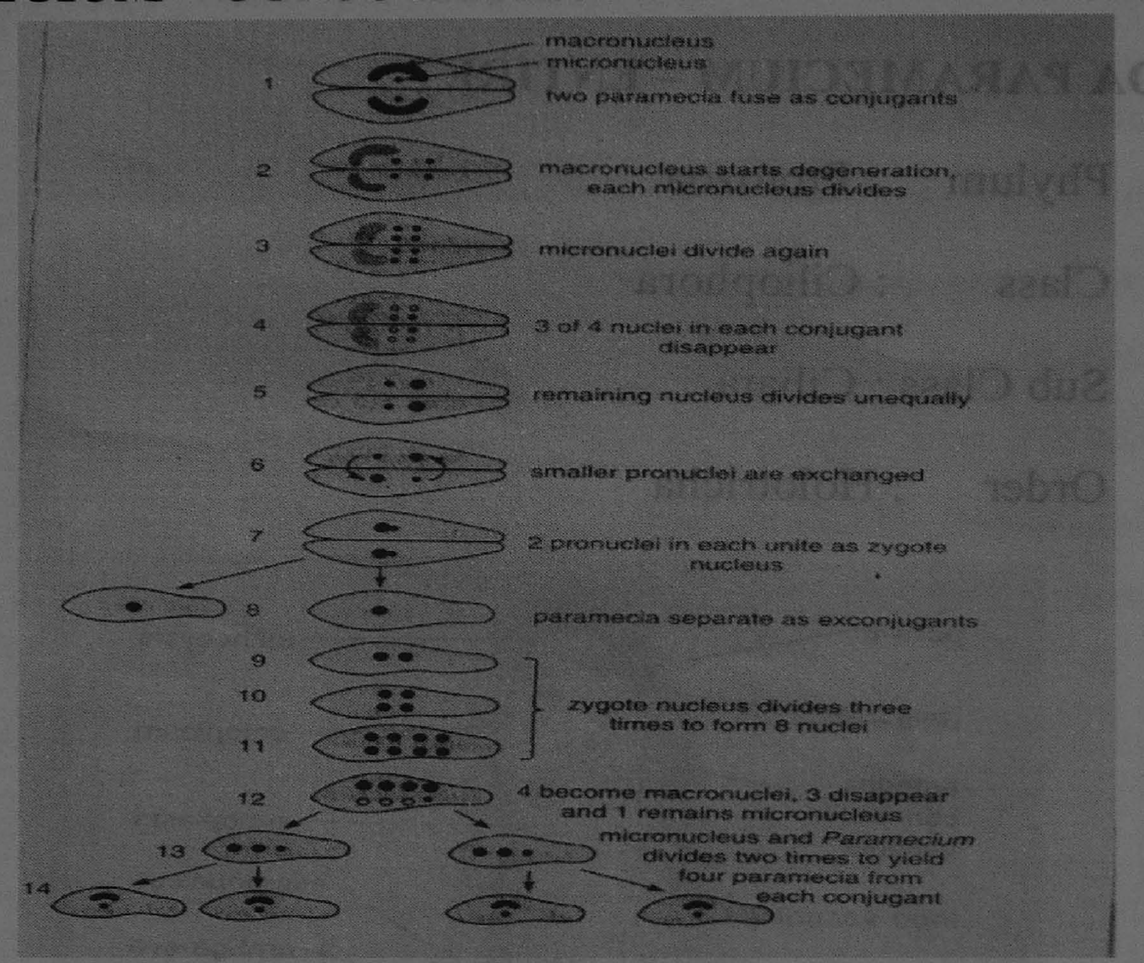
Sub Class : Ciliata

Order : Holotricha



Paramecium is a free swimming fresh water animal.
It is commonly called slipper animalcule because it looks like a slipper.
It is a minute, microscopic and a unicellular animal.
The entire body is covered by cilia.
The cytoplasm contains two nuclei: Macro and Micro nucleus.
The endoplasm contains two contractile vacuoles.
It exhibits holozoic nutrition.
It reproduces by binary fission.
Sexual reproduction through syngamy, conjugation, autogamy, endomixis, hemixis, cytogamy and parthenogenesis.

1.2. PARAMECIUM – CONJUGATION



Conjugation is one type of sexual reproduction in paramecium.

During conjugation temporary union of 2 individuals occur for the exchange of nuclear material.

The 2 individuals meet and attach together by their ventral sides.

The two individuals involved in conjugation are called conjugants.

The macronucleus disintegrates.

The micronucleus undergoes reduction division (meiosis).

The meiosis results in a large female pronucleus and a small male pronucleus.

The male pronucleus moves into the other conjugants through conjugation canal.

The male and female pronucleus fuse together to form a zygotic nucleus.

It results in 8 daughter paramecia.

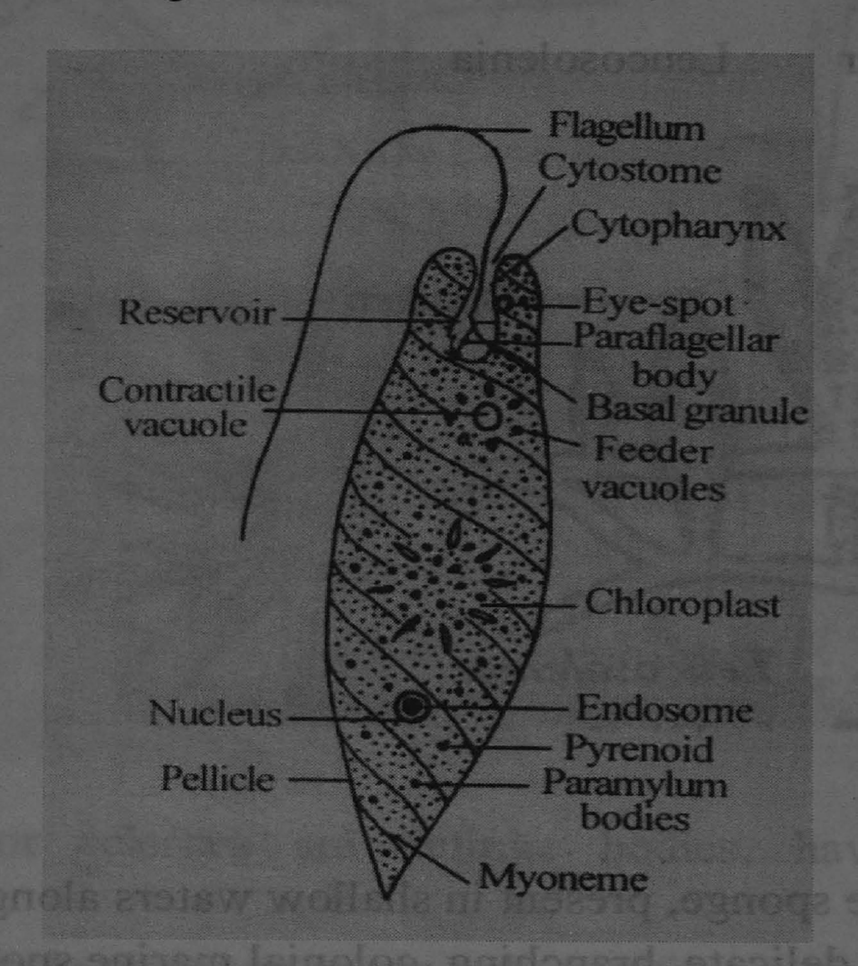
Conjugation produces a new combination of genes and rejuvenation.

1.3.EUGLENA

Phylum : Protozoa

Class : Flagellata

Order : Euglenoidea



Euglena is a freshwater flagellate protozoan.
It is microscopic and spindle shaped organism.
It is covered by a pellicle which is green in colour.
The anterior end is blunt, the middle part is wider, while posterior end is pointed.
The anterior end has funnel shaped cytostome or cell mouth, a short tubular cytopharynx, all as a canal for escape of fluid from the reservoir.
Presence of a large osmoregulatory body, the contractile vacuole.
A single, long, whip like flagellum emerges out of the cytostome which helps in locomotion.
Presence of eye spot on the anterior end.
Cellular components golgi apparatus, endoplasmic reticulum, mitochondria and chloroplast are present.
It reproduces by longitudinal binary fission.

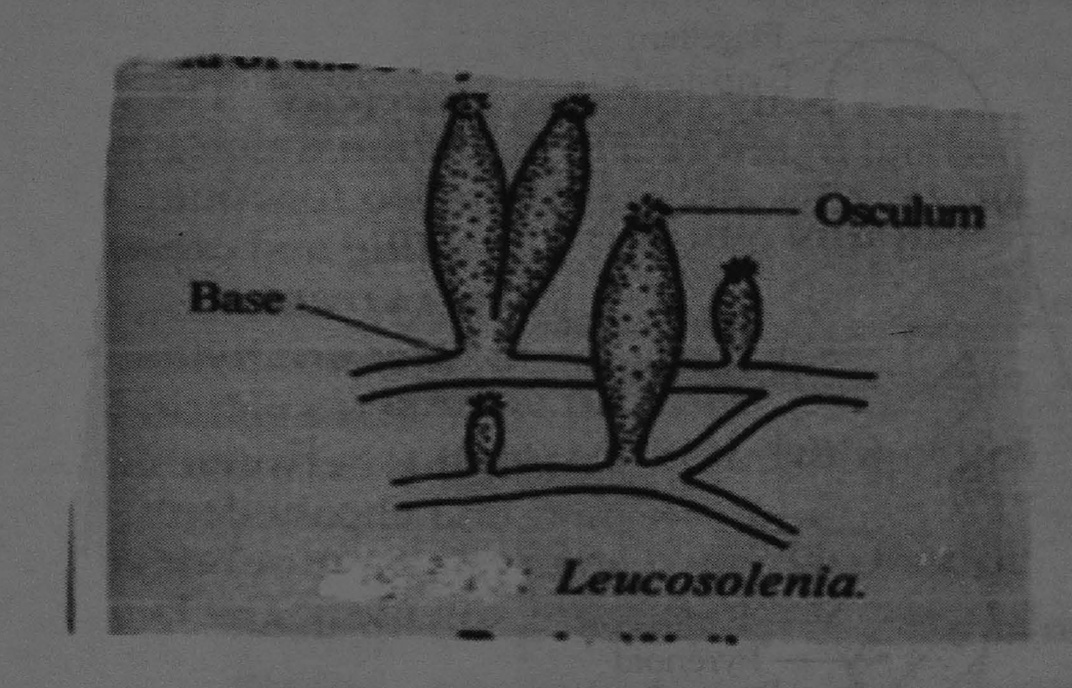
2.PORIFERA

Phylum : Porifera

Class : Calcarea

Sub Class : Homocoea

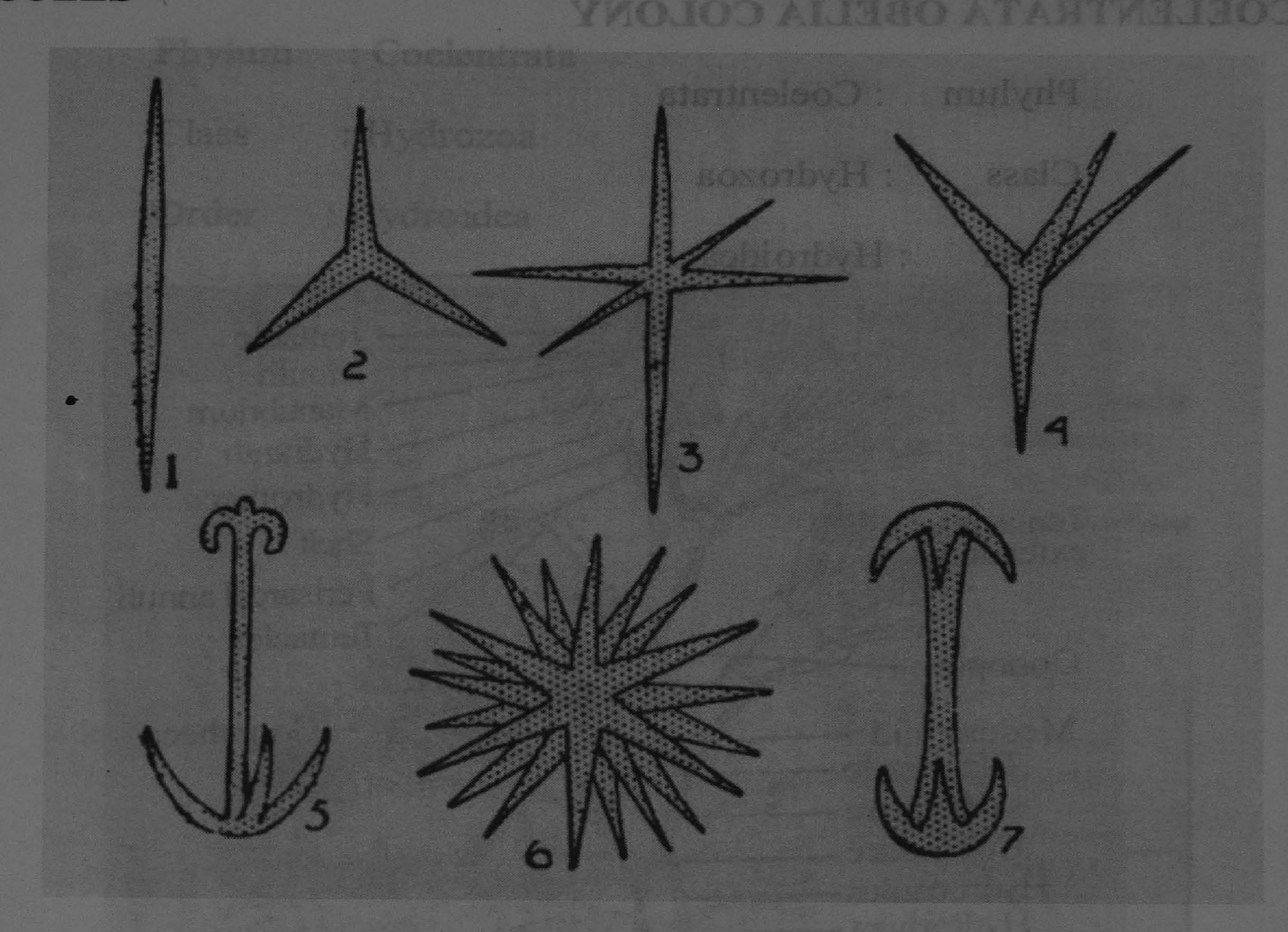
Order : Leucosolenia



: *Leucosolenia.*

It is a marine sponge, present in shallow waters along the shore.
It is a small, delicate, branching, colonial marine sponge.
Leucosolenia is whitish in colour.
The colony consist of few simple, vase like, cylindrical individuals each terminating in an osculum.
The body wall is thin, an outer epidermis, the pinacoderm and an inner endodermis, the choanoderm separated by a jelly like mesenchyme.
The food comprises the plankton, microscopic animals and plants and bits of organic matter.
Digestion is always intracellular.
It reproduces both asexually and sexually.
Leucosolenia reproduces asexually by budding.

SPICULES



The spicules or sclerites are definite bodies, having a crystalline appearance.

It consists of simple spines or spines radiating from a point.

They have an axis of organic material calcium carbonate or hydrated silica.

They are of 2 kinds. Megascleres and Miroscleres.

Spicules are classified on the basis of their axes and rays. Words designating the number of axes end in axons, those referring to the number of rays end in actine or actinal.

Megascleres are the largest skeletal spicules, the chief supporting framework of the sponge. Egs.monaxon, triaxon, tetrasxons, polyaxons and spheres.

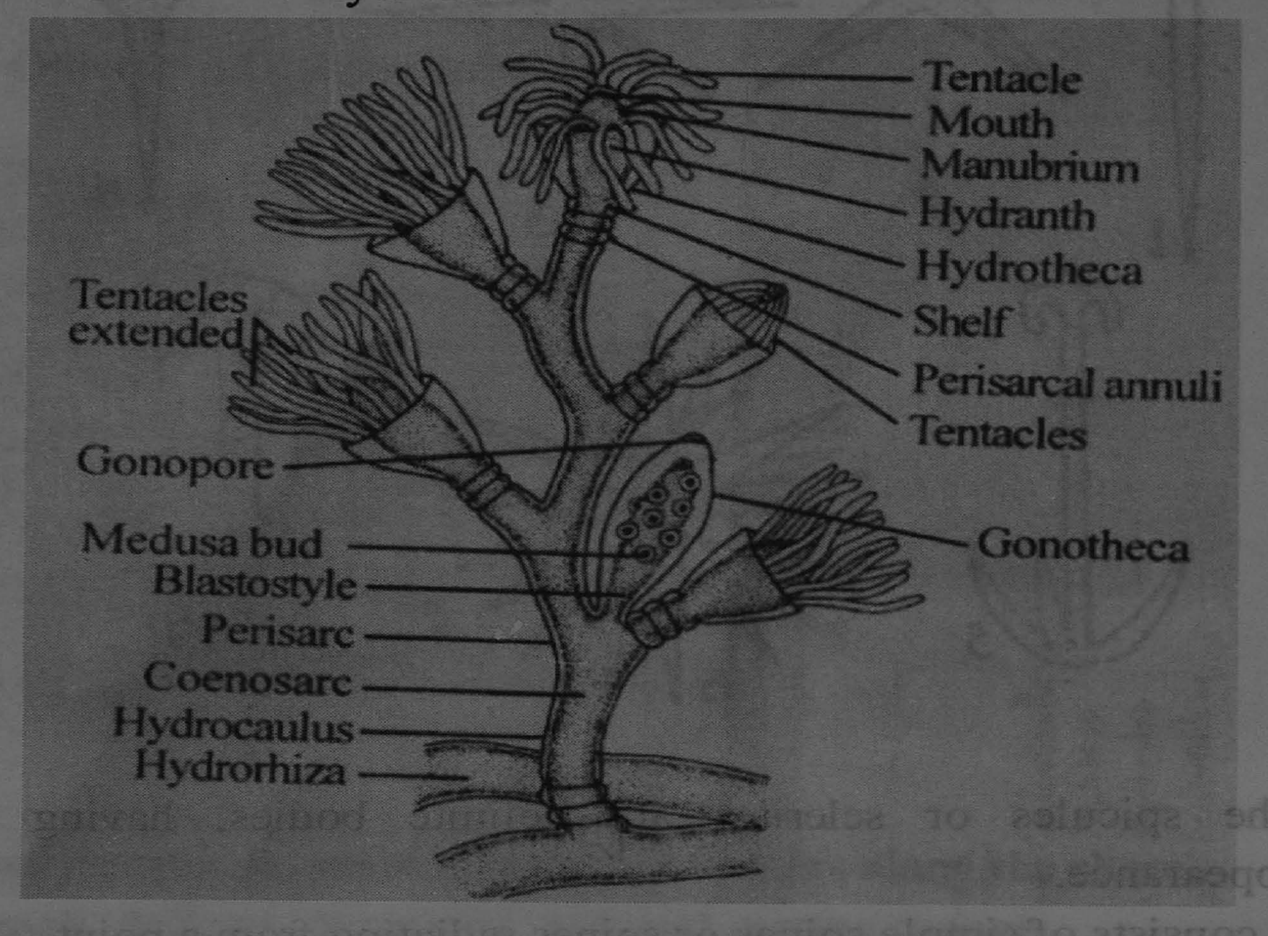
Microscleres the smaller fresh spicules that occur throughout the mesenchyme.

3. COELENTRATA OBELIA COLONY

Phylum : Coelentrata

Class : Hydrozoa

Order : Hydroidea



It is a marine colonical form.

The colony consists of a basal horizontal hydrorhiza which is attached with the substratum and number of vertical branches known as hydrocauli arising from hydrorhiza.

The hydrocauli and hydrorhiza are covered by a chitinous perisarc.

The colony is trimorphic having 3 types of zooids, namely polyps (or) hydranth, blastosytles and medusa.

The polyp is covered by hydrotheca. The hypostome is surrounded by a number of tentacles. It is nutritive in function.

The blastostyle (or) reproductive zooid is club-shaped without mouth and tentacles.

It is enclosed by gonotheca. It gives rise to buds which develop into medusa.

The life history of obelia exhibits an alternation of generation of metagenesis.

OBELIA - MEDUSA

Phylum : Coelentrata

Class : Hydrozoa

Order : Hydroidea



The medusa is the sexual zooid of the obelia colony.

It is formed from blastostyle by budding.

The single blastostyle can produce several medusae.

The medusa is in the form of tiny umbrella floating in the water.

It is about 7mm in diameter.

One side of the medusa is convex and is called exumbrella.

A small short handle like structure hangs from sub-umbrella is called manubrium.

The medusa has well developed radial symmetry.

The body wall is diploblastic formed of ectoderm and endoderm.

The medusa has eight statocysts.

Statocysts are the sense organs, it helps in maintaining equilibrium and muscular coordination.

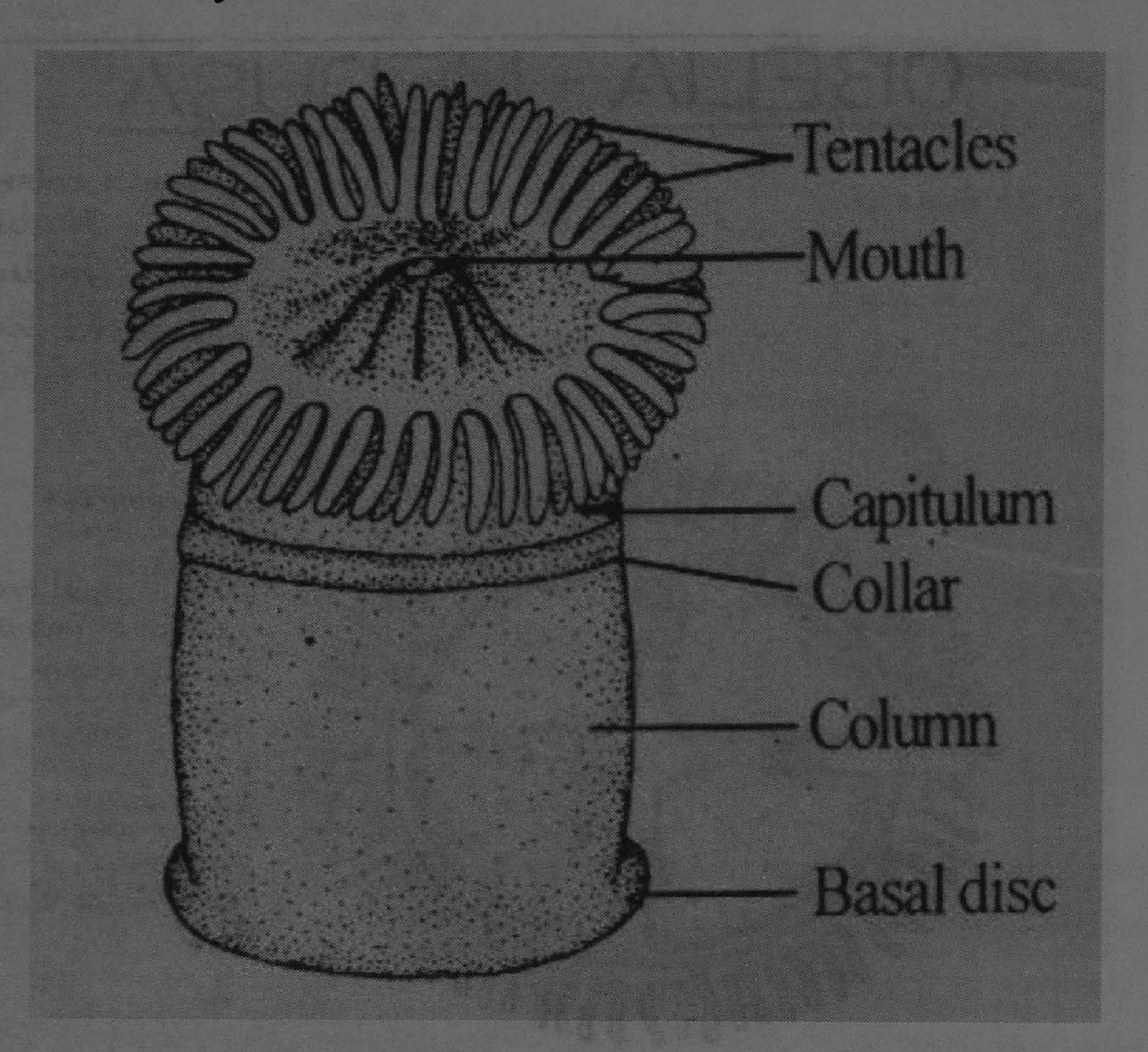
The medusa is the sexual zooid.

METRIDIUM SEA ANEMONE

Phylum : Coelentrata

Class : Hydrozoa

Order : Hydroidea



It is marine form and is commonly known as sea anemone.

The body is cylindrical and radially symmetrical divisible into 3 distinct regions namely pedal disc, column and oral disc.

Oral disc is lobed and flat with a slit like mouth in the centre which is surrounded by numerous tentacles.

Mouth leads into a short gullet which finally opens into a gastro vascular cavity.

Gastro vascular cavity is divided into compartments usually by six parts of mesenteries.

A sexual reproduction by fragmentation and budding.

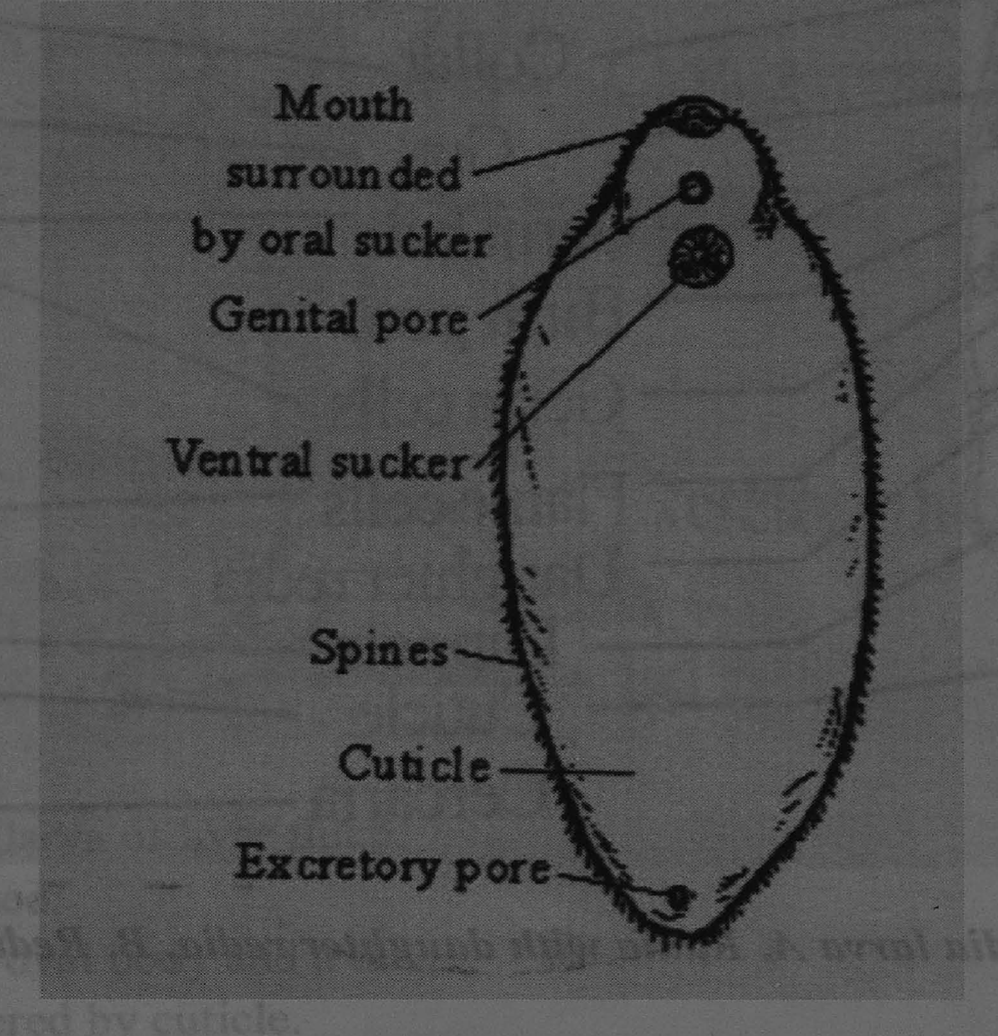
It exhibits commensalism with hermit crab.

4. HELMINTHES - Liver Fluke (Fasciola Hepatica)

Phylum : Platyhelminthes

Class : Trematoda

Order : Digenea



Fasciola Hepatica is found in liver and biliary passages of sheep, ox, horse, dog, elephant, man, monkey and kangaroo.

It is cosmopolitan in distribution.

The body is leaf like, dorso ventrally flattened measuring 18-15mm in length and 4-15mm in breath.

Anterior end has mouth and surrounded by oral sucker is called acetabulum.

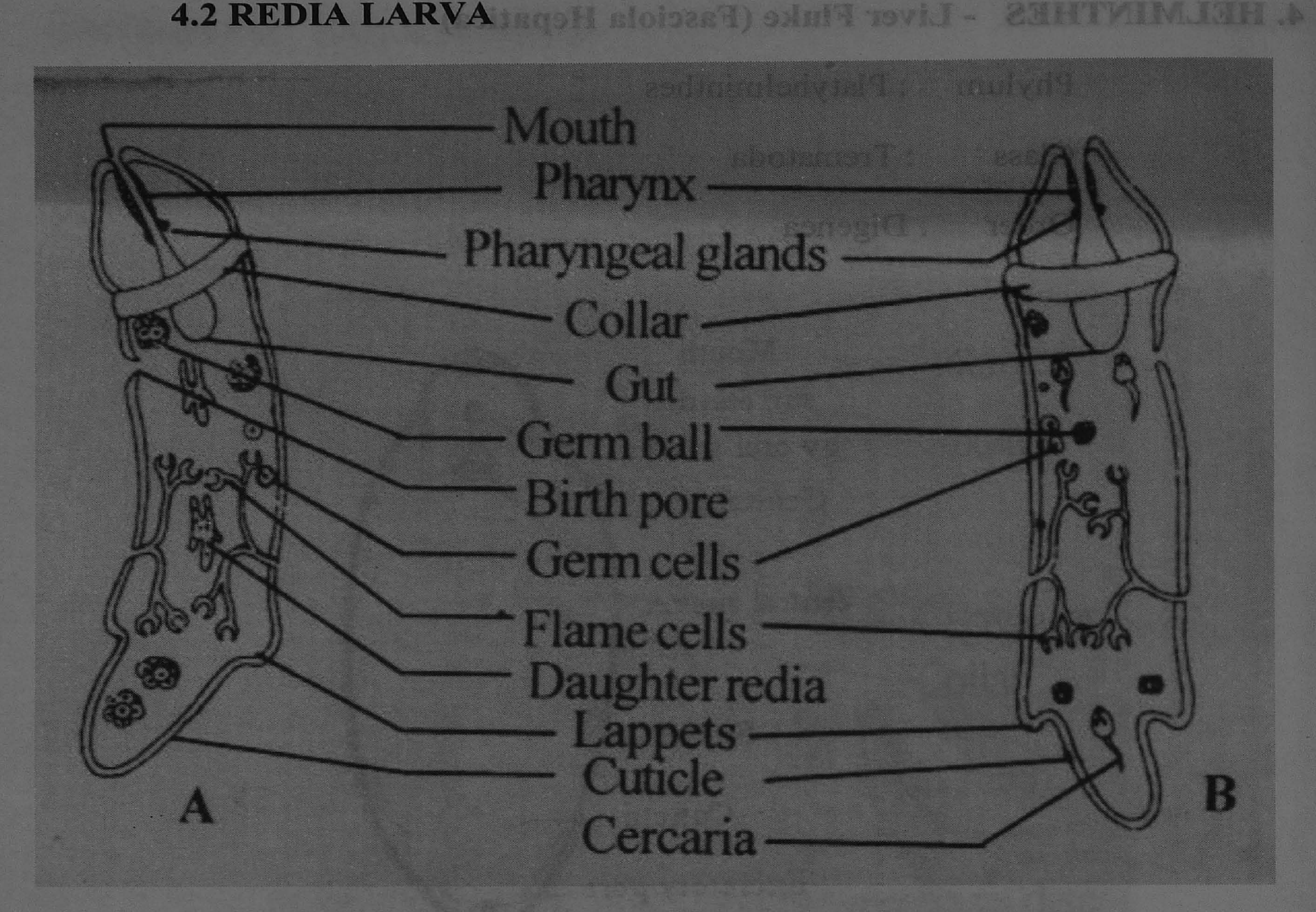
Between the oral and the ventral suckers is a gonopore.

Excretory pore is found at posterior end.

It is a hermaphrodite.

Development is indirect. The life cycle involves 2 hosts sheep and snail.

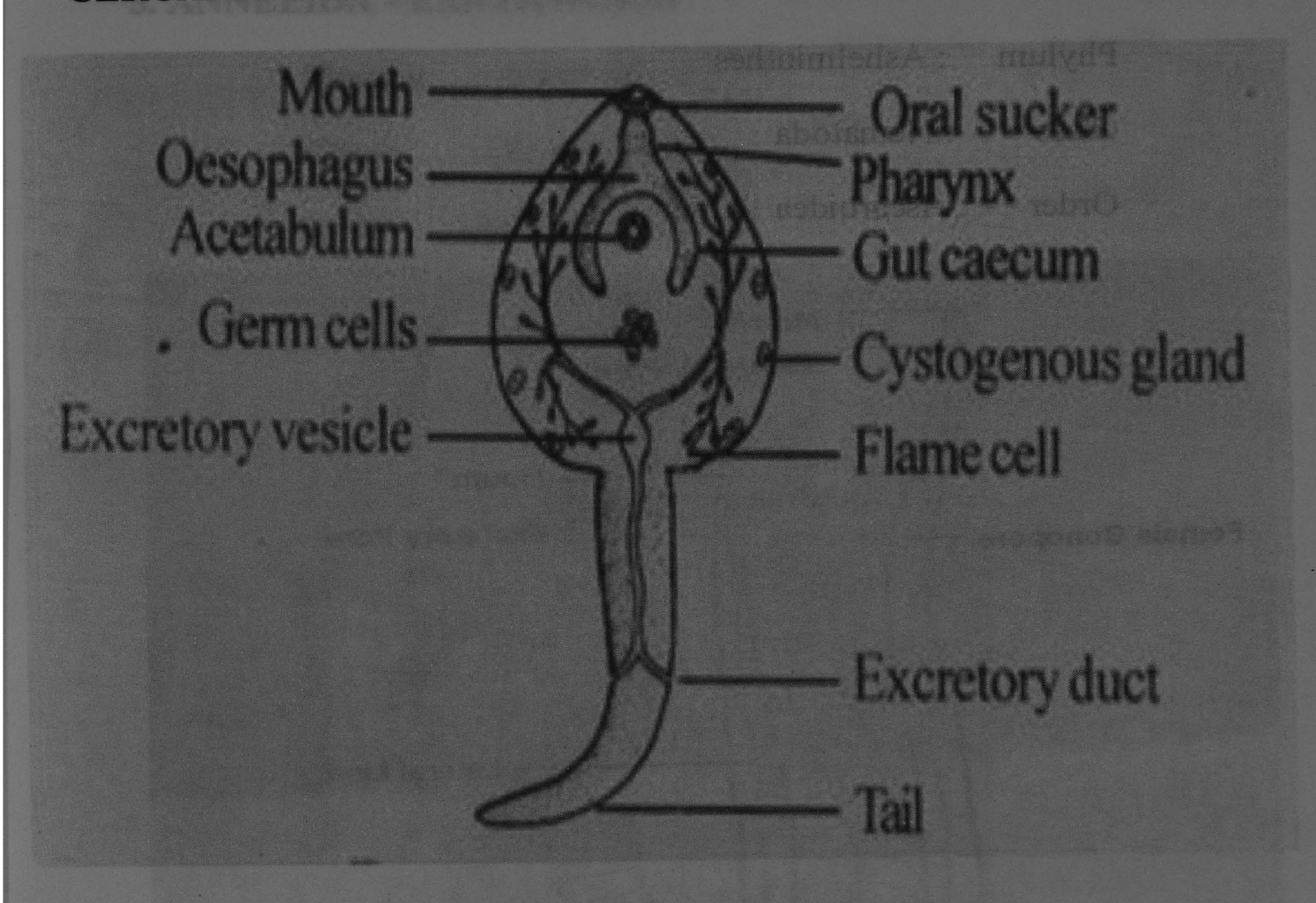
4.2 REDIA LARVA



Redia larva A. Radia with daughter redia, B. Redia with cercaria

It is the larva of liver fluke.
It lives in the digestive glands of the snail.
It is cylindrical in shape.
The body is covered by cuticle.
The anterior end has a mouth behind the mouth is collar. Behind the collar an opening called birthpore.
Near the posterior end a pair of projection is found. They are called lappets used for locomotion.
Two protonephridia are located inside the body.
The germ cells of redia develop into daughter redia.
The daughter redia develops into the next larva called cercaria

CERCARIA LARVA



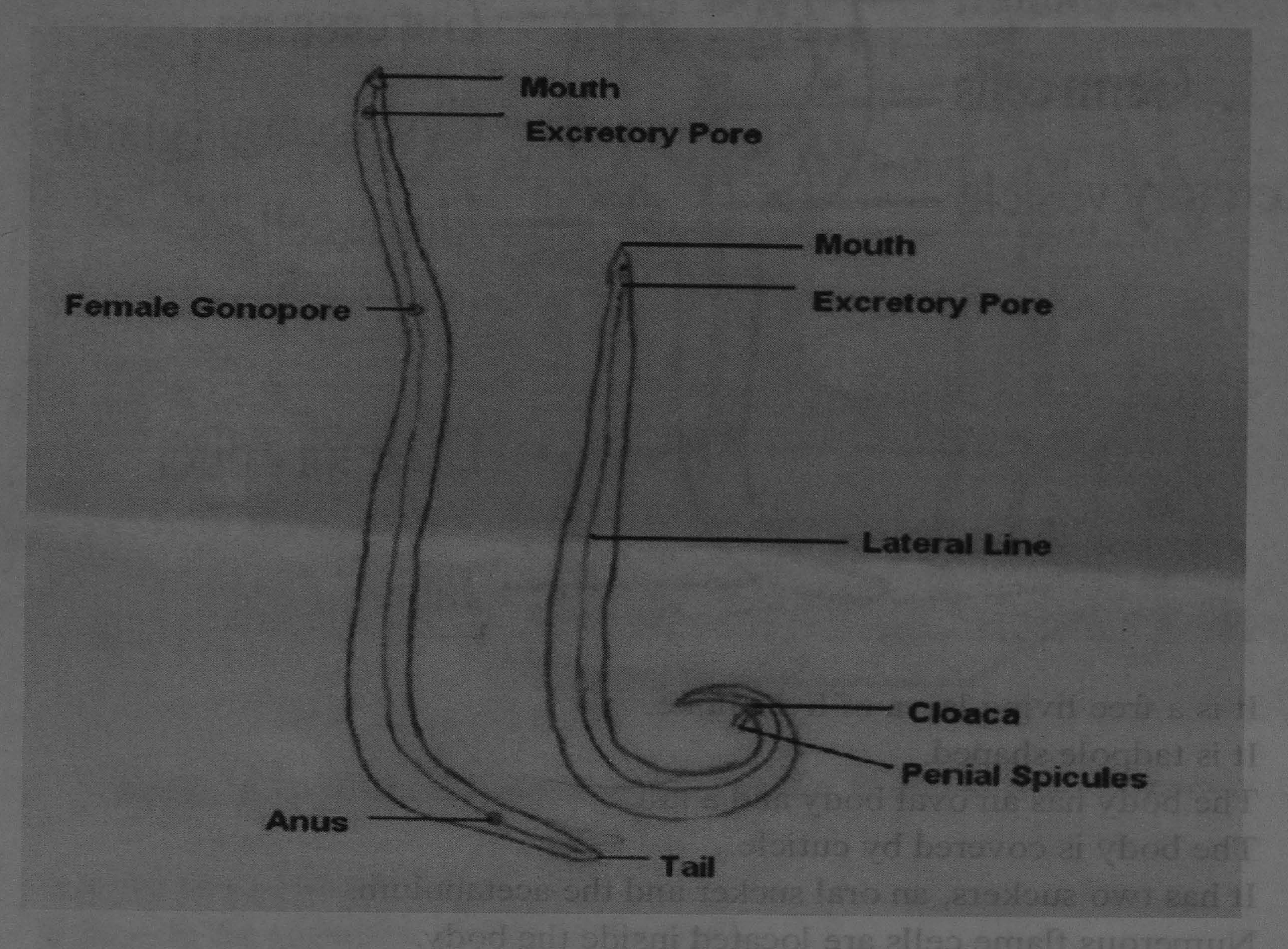
It is a free living larva of liver fluke.
It is tadpole shaped.
The body has an oval body and a tail.
The body is covered by cuticle.
It has two suckers, an oral sucker and the acetabulum.
Numerous flame cells are located inside the body.
The body wall contains many cytogenous glands.
The body cavity is filled with groups of germ cells.
The cercaria lives for three days and it is transformed into another larva called metacercaria.

ASCARIS MALE AND FEMALE

Phylum : Ashelminthes

Class : Nematoda

Order : Ascaroidea



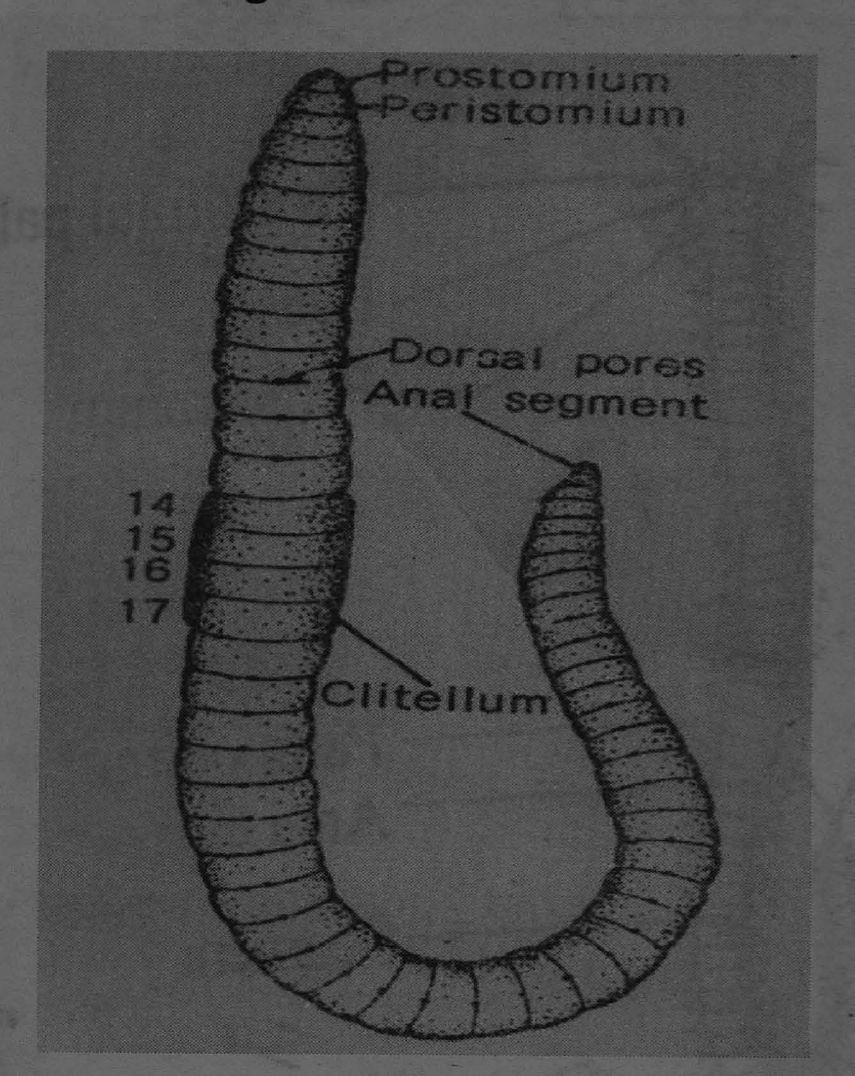
Ascaris lumbricoides is found in the intestine of man.
It is endoparasite.
It is commonly known as roundworm.
It shows sexual dimorphism with separate male and female individuals.
The female ascaris is larger than the male.
The posterior end of the female is straight but in the male it is curved ventrally like a hook.
The mouth is situated at the anterior end is guarded by three lips.
Excretory pore lies at a distance of about 2mm from the anterior end.
Life cycle includes a rabidity worm.
Movement of larva outside the intestine is called extra intestinal migration.
It causes a disease called ascarisis.

5. ANNELIDA - EARTHWORM

Phylum : Annelida

Class : Oligcohaeta

Order : Neooligochaeta



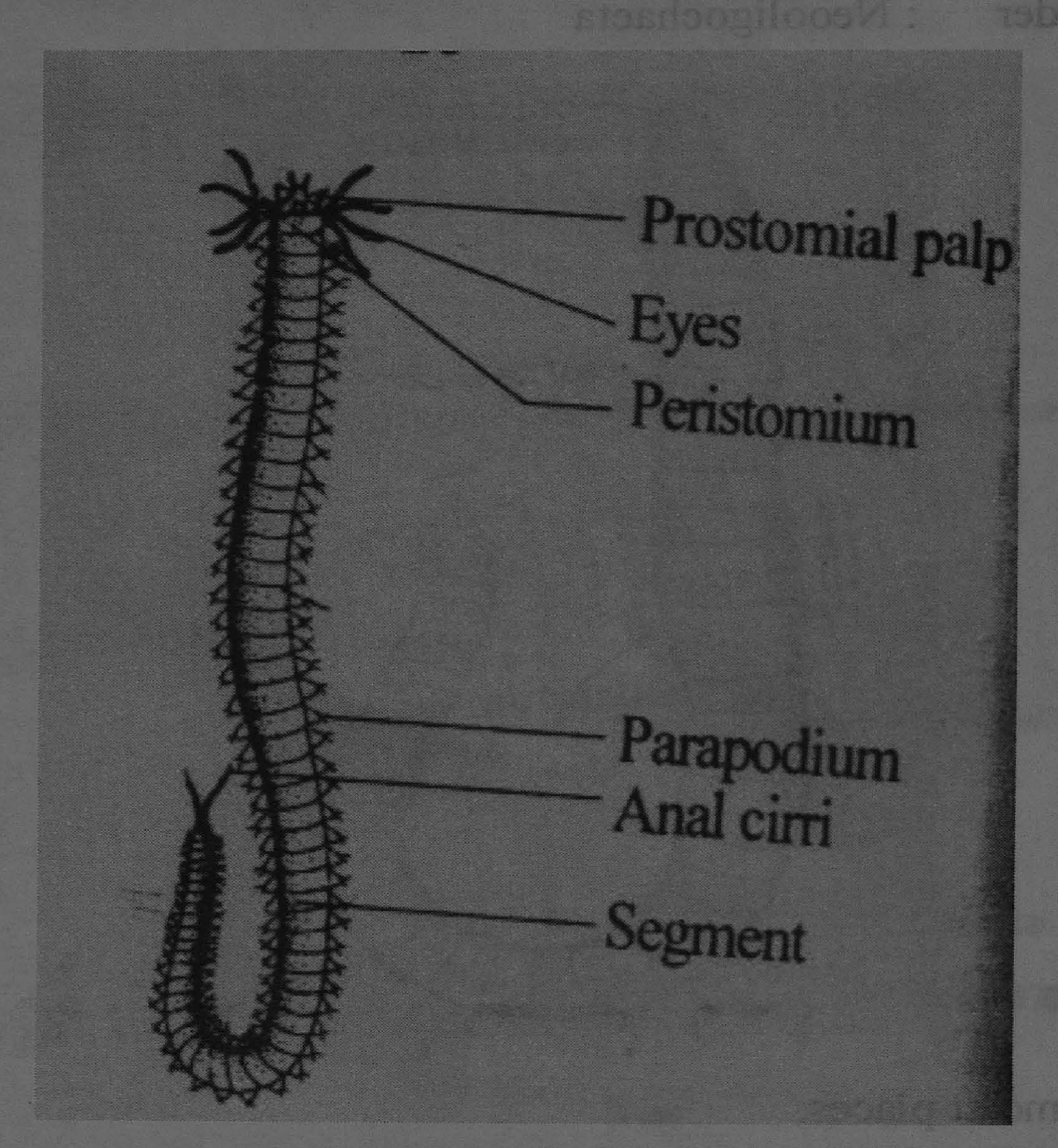
It lives in moist places.
It feeds on detritus.
It is a burrowing animal.
It has long cylindrical body with pointed ends.
The body is divided into 100-120 segments.
Earthworm has no head. The first segment is called peristomium.
The peristomium bears the mouth.
The clitellum extends between 14^{th} and 17^{th} segment.
A pair of female genital aperture is present in 14^{th} segment.
A pair of male genital pore is present in the 18^{th} segment.
Excretory organs are nephridia.
It is a hermaphrodite.
The circulatory system is closed type.
Fertilization is external, development is direct.

NEREIS

Phylum : Annelida

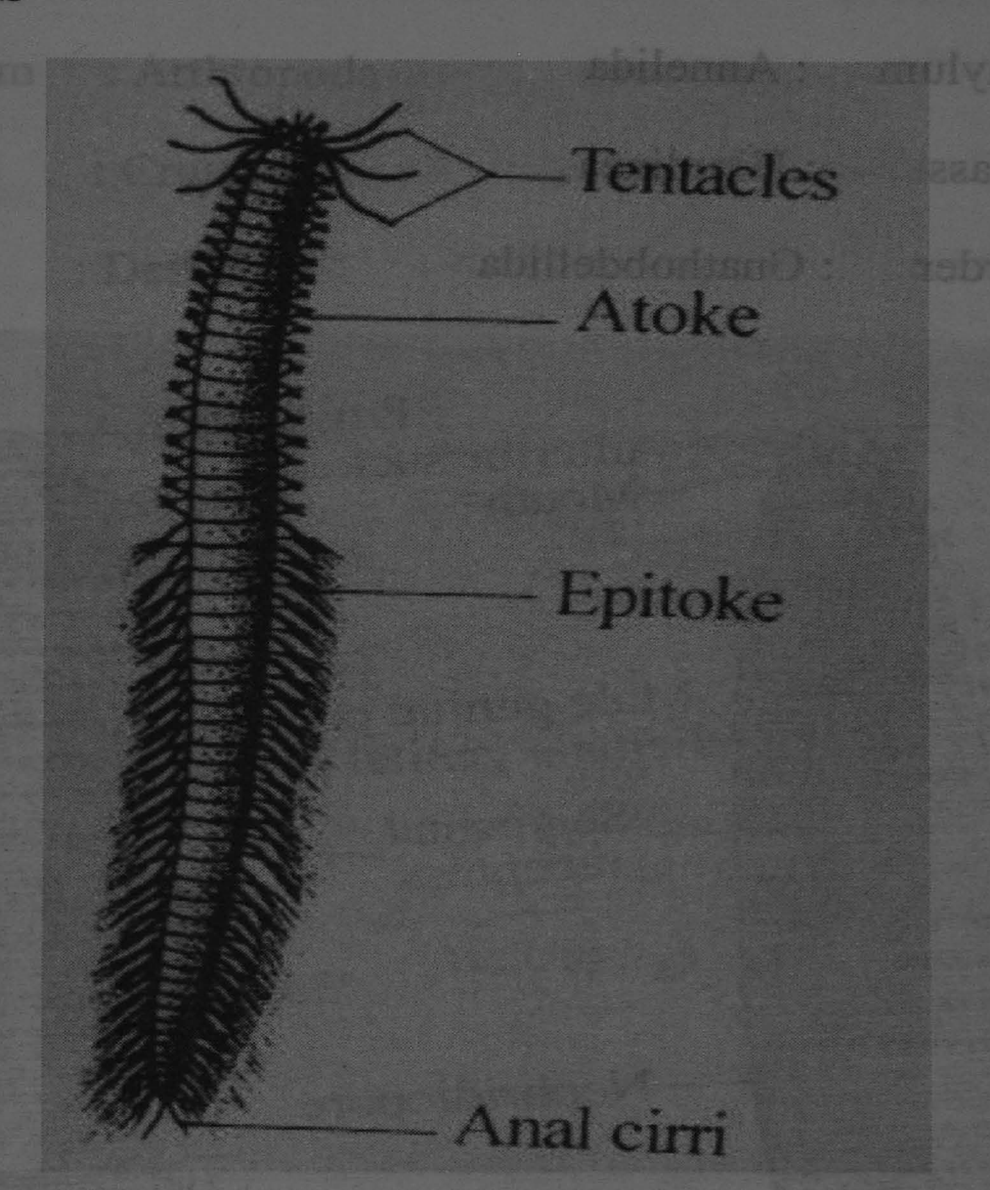
Class : Polychaeta

Order : Errantia



Nereis is commonly called rag-worm.
It is marine annelid.
It leads a burrowing mode of life.
It is nocturnal in habit.
The body is metamerically segmented.
The head is made up of prostomium and a peristomium.
The peristomium has two pairs of peristomial tentacles, two pairs of eyes and mouth.
The last segment is called anal segment.
Nereis is carnivorous animal.

HETERONEREIS



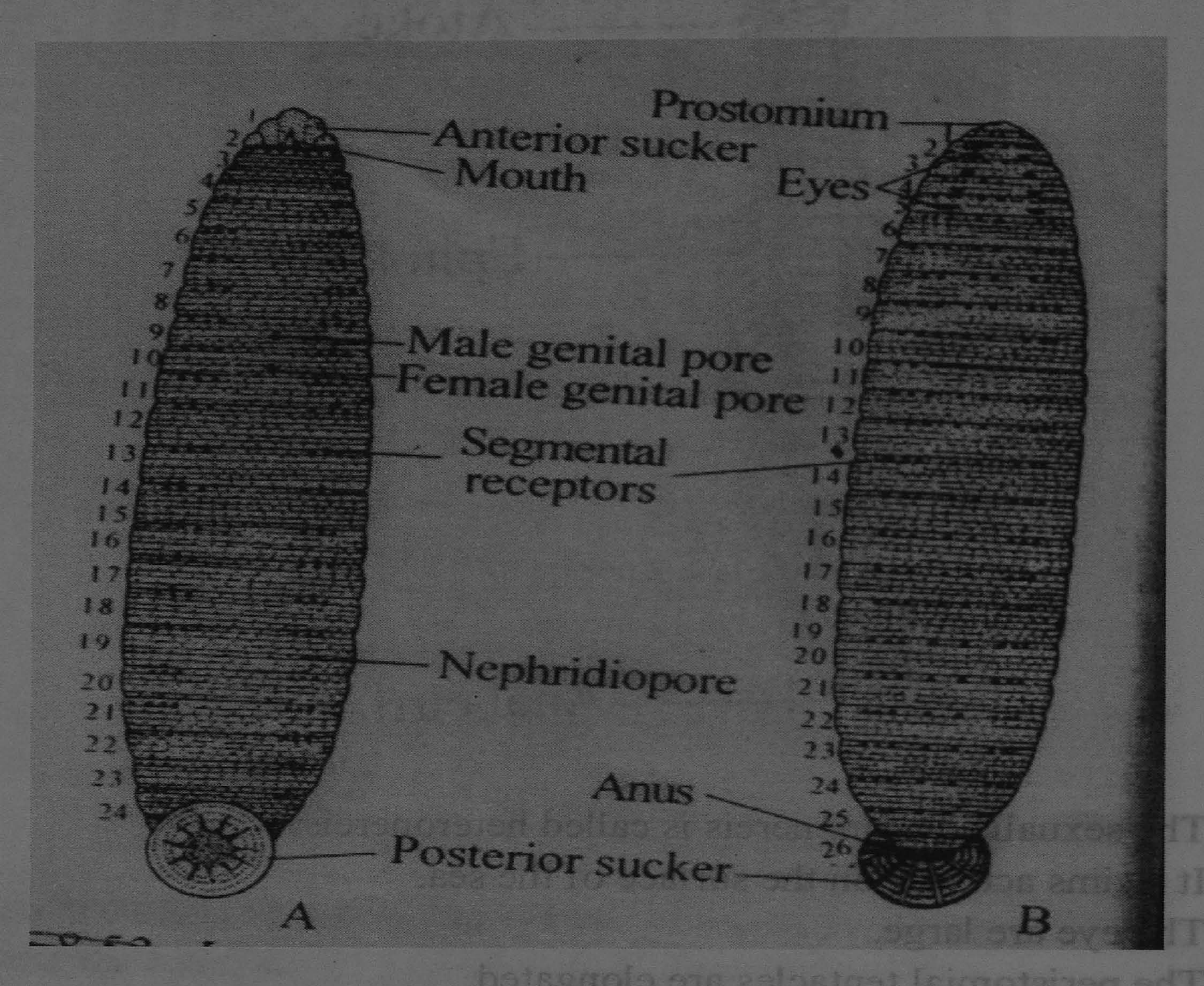
- The sexually mature nereis is called heteronereis.
- It swims actively on the surface of the sea.
- The eye are large.
- The peristomial tentacles are elongated.
- Anal cirri are elongated.
- The pygidium develops special sensory papillae.
- Intestine becomes dorsoventrally flattened, reduced and functionless.
- The body is divided into an anterior non-sexual part, atoke and posterior sexual part the epitoke.
- They exhibit sexual dimorphism.
- The heteronereis stage is brought about by the action of hormones.

LEECH

Phylum : Annelida

Class : Hirudinea

Order : Gnathobdellida



Leech A. Ventral view; B. Dorsal view

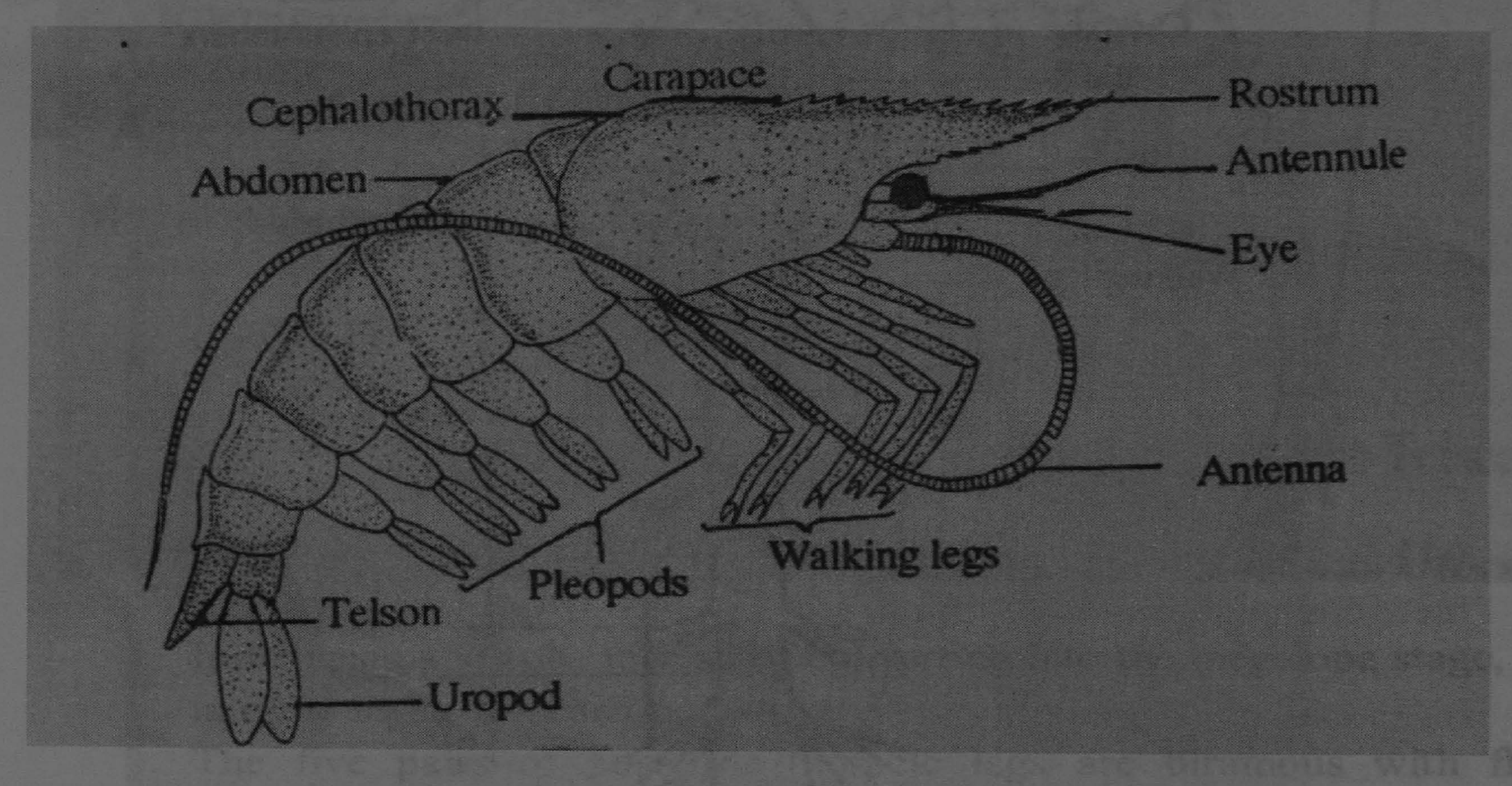
It is commonly called cattle leech.
It is a multicellular, and lives in ponds, tanks, etc.
It is an endoparasite feeding on the blood of cattle and man. So it is called sanguivorous.
It is cylindrical in shape.
The dorsal surface is olive green in colour and the ventral surface is yellowish in colour.
The body is metamerically segmented.
Leech has two suckers like anterior and posterior.
There are 17 pairs of nephridiopores.
Male genital aperture is found in 10th segment.
Female genital aperture is found in 11th segment.

6. ARTHROPODA – PRAWN (Penaeus)

Phylum : Arthropoda

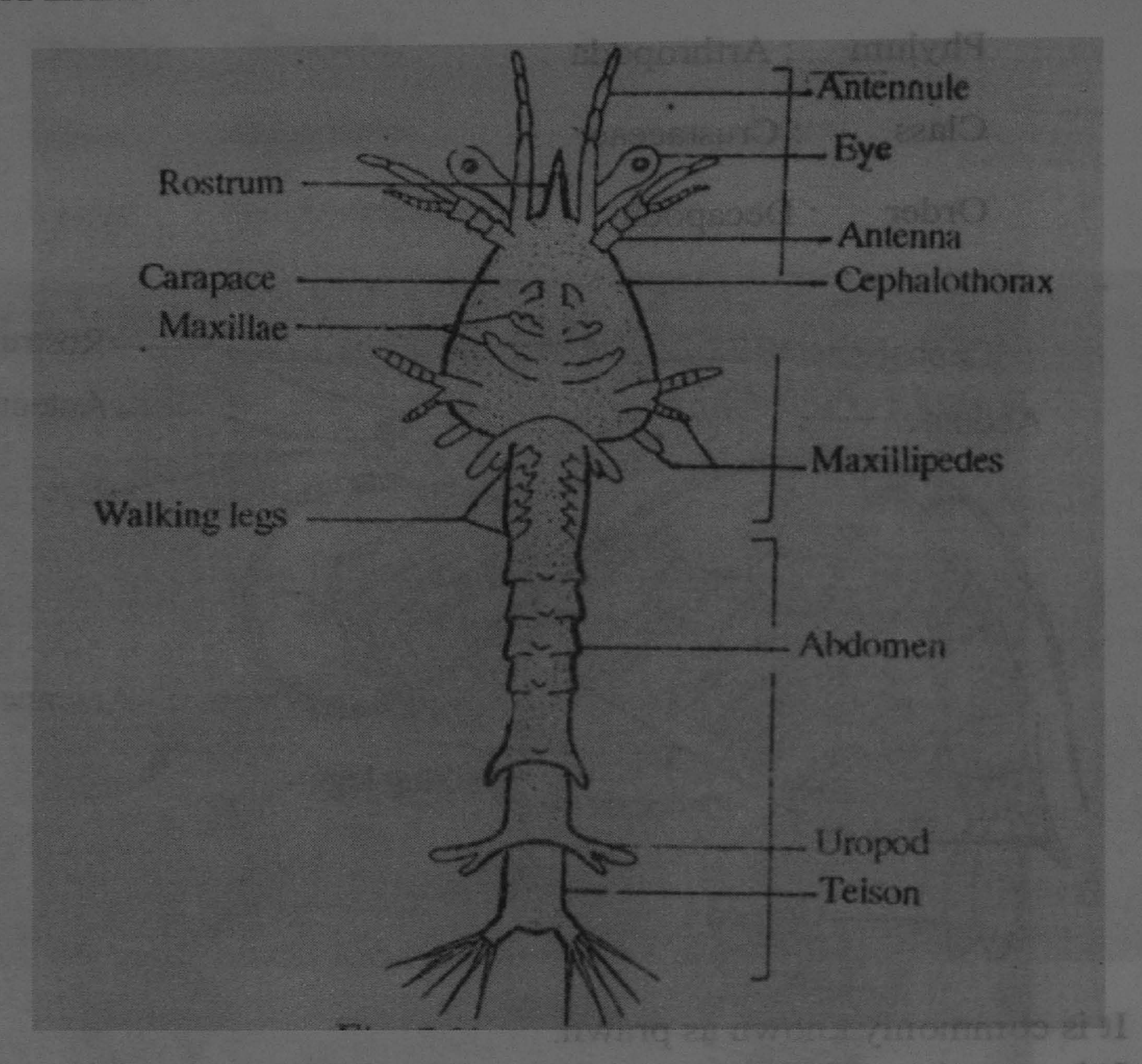
Class : Crustaceae

Order : Decapoda



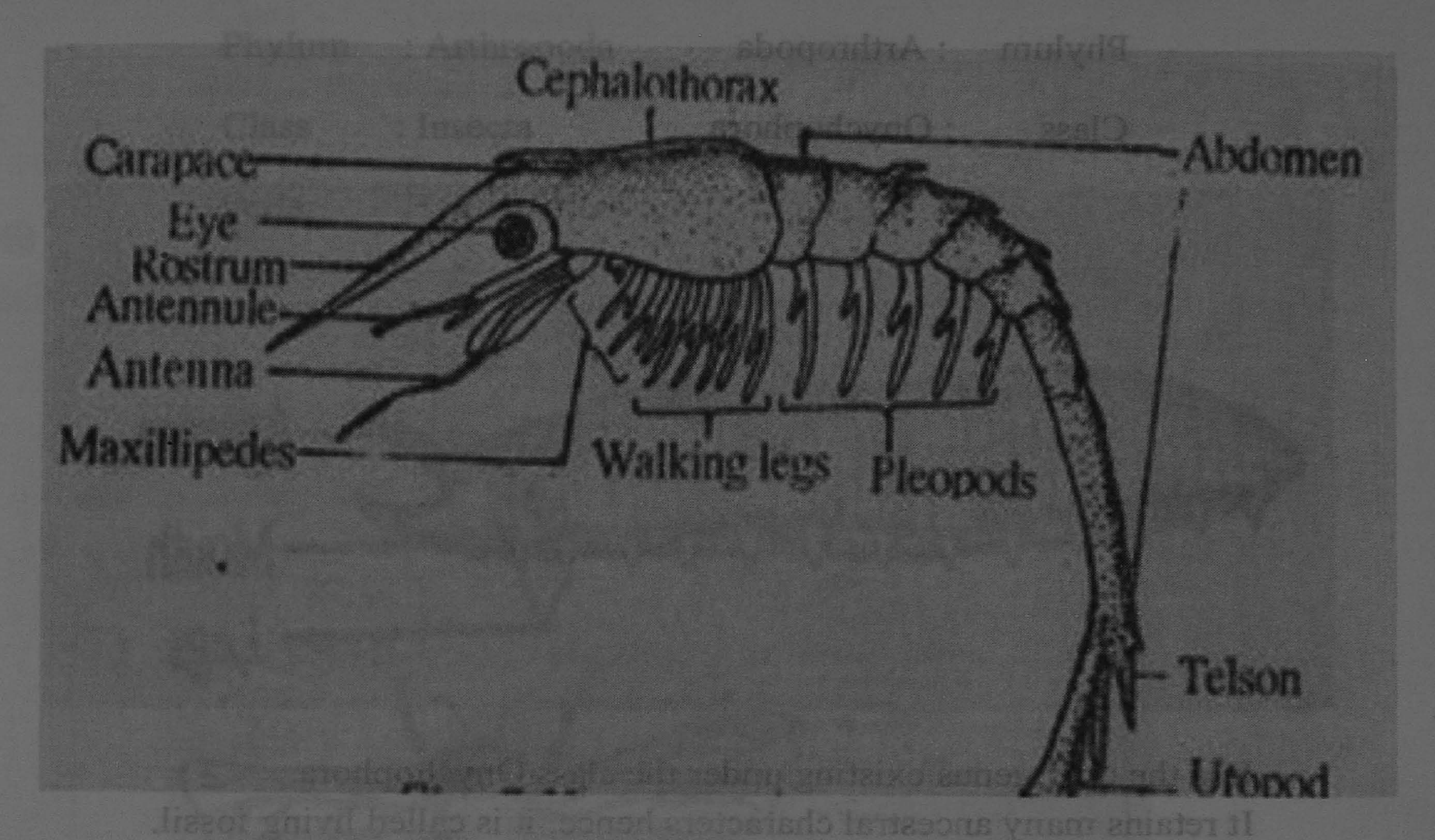
It is commonly known as prawn.
It is a marine animal.
The body is covered with cuticle.
The body is formed by nineteen segments.
The body is divisible into cephalothorax and abdomen.
The head bears a pair of compound eyes.
The thorax has walking legs.
Gills are the respiratory organ.
Development is indirect.
The larval forms are nauplius, zoea and mysis.

6.1 ZOEA LARVA



Zoea is the second important larva of the crustacea.
The protozoean stage is succeeded by the zoea stage.
In decapoda, the egg is hatched directly into the zoea larva.
The anterior caphalothorax is covered with carapace.
Long spines are present. They are anterior rostral, a median dorsal and two lateral spines.
Presence of a pair of compound eyes.
The antennae are used as oars.
The long abdomen is made up of 6 segments without the appendages

6.2 MYSIS LARVA (SCHIZOPOD)



In Penaeus, the zoea instead of converting into the megalopa stage, moults into the mysis or schizopod larva.

The five pairs of posterior thoracic legs are biramous with flagellar exopodites are used for locomotion.

The abdomen elongates and the biramous pleopods begin to appear.

The thoracic legs are used for swimming.

The abdomen ends in a telson.

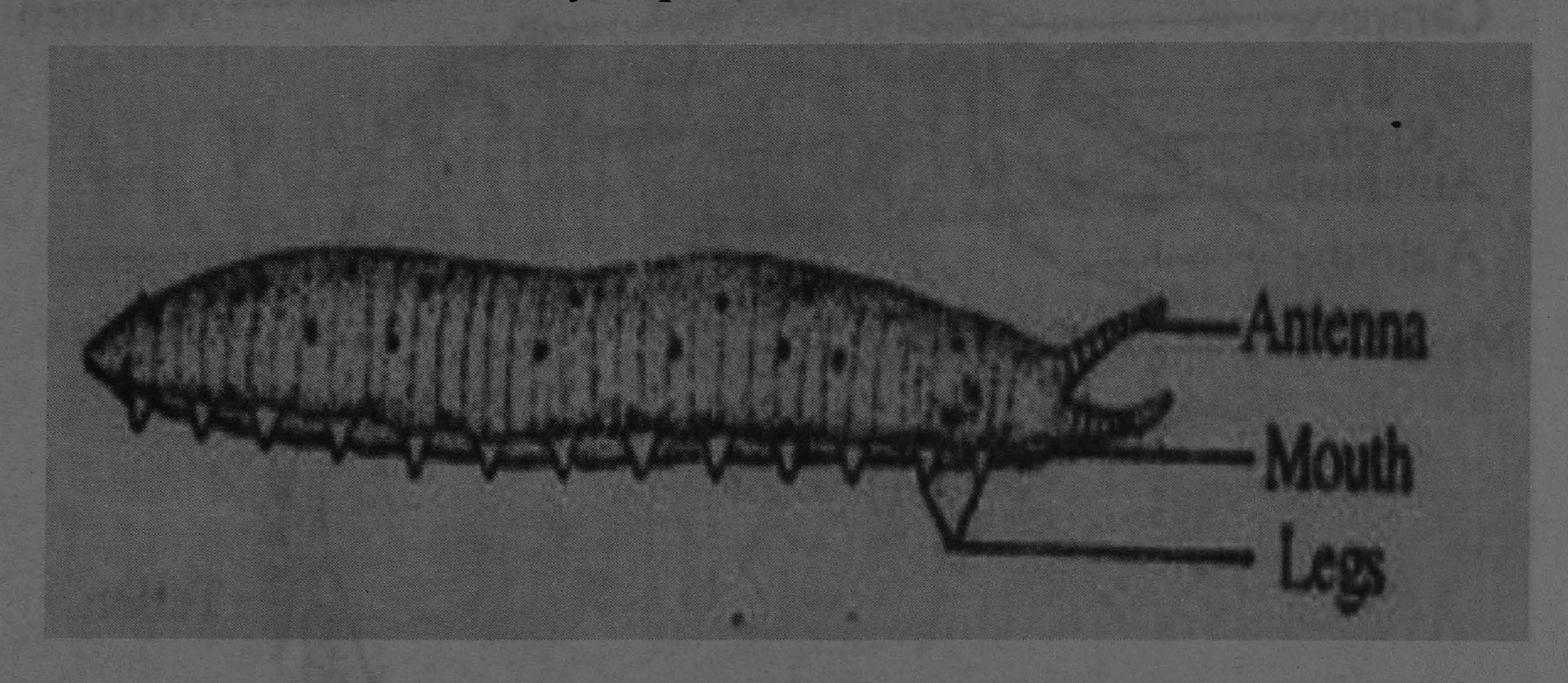
The eyes are stalked and compound.

The mysis larva differs from the adult mysis in the absence of a brood pouch between the thorax and a pair of statocysts.

PERIPATUS

Phylum : Arthropoda

Class : Onychophora



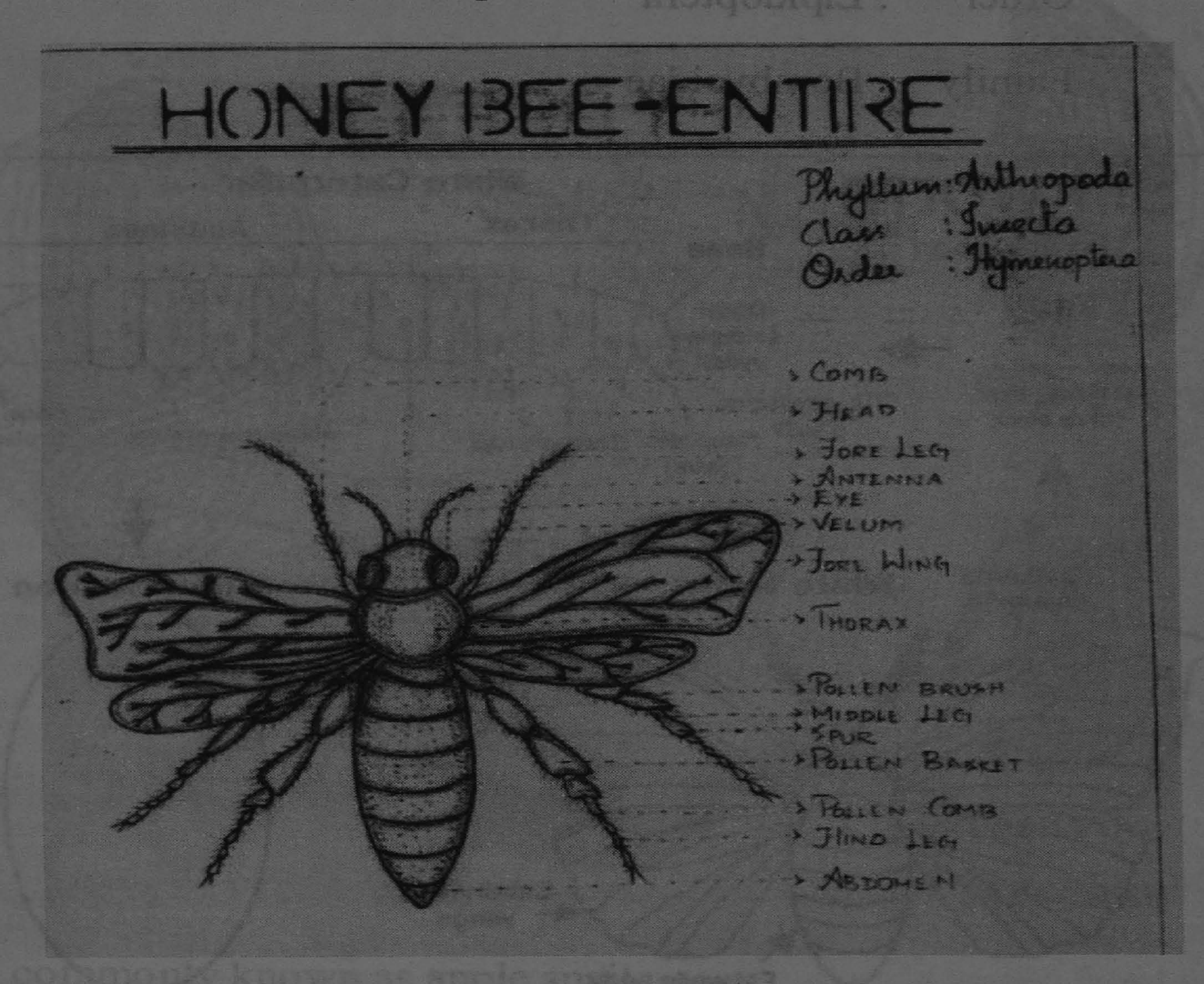
It is the only genus existing under the class Onychophora.
It retains many ancestral characters hence, it is called living fossil.
It is a connecting link between annelida and arthropoda.
It exhibits discontinuous distribution.
It is terrestrial, nocturnal and insectivorous in habit.
It looks like a caterpillar growing to a length of 1.5cm to 15cm.
The body consists of a head and a trunk.
The head bears a pair of antennae, a pair of eyes, a pair of oral papillae and a mouth.
The body wall is dermomuscular.
The body cavity is a haemocoel.
The sexes are separate.
The fertilization is internal and the development is direct.
It excretes uric acid. Hence Peripatus in the uricotelic animal.

HONEY BEE

Phylum : Arthropoda

Class : Insecta

Order : Hymenoptera



It is a common honey bee.
It is a social and colonial insect.
It built and lives in bee hives.
The colony is comprised of workers, drones and queen.
The body consists of head, thorax and abdomen.
The head bears a pair of eyes and a pair of antennae.
The mouth parts are chewing and lapping type.
It feeds on the nectar.
There are two pairs of wings and three pairs of legs.
The abdomen bears wax gland and sting.
It gives us honey and wax.

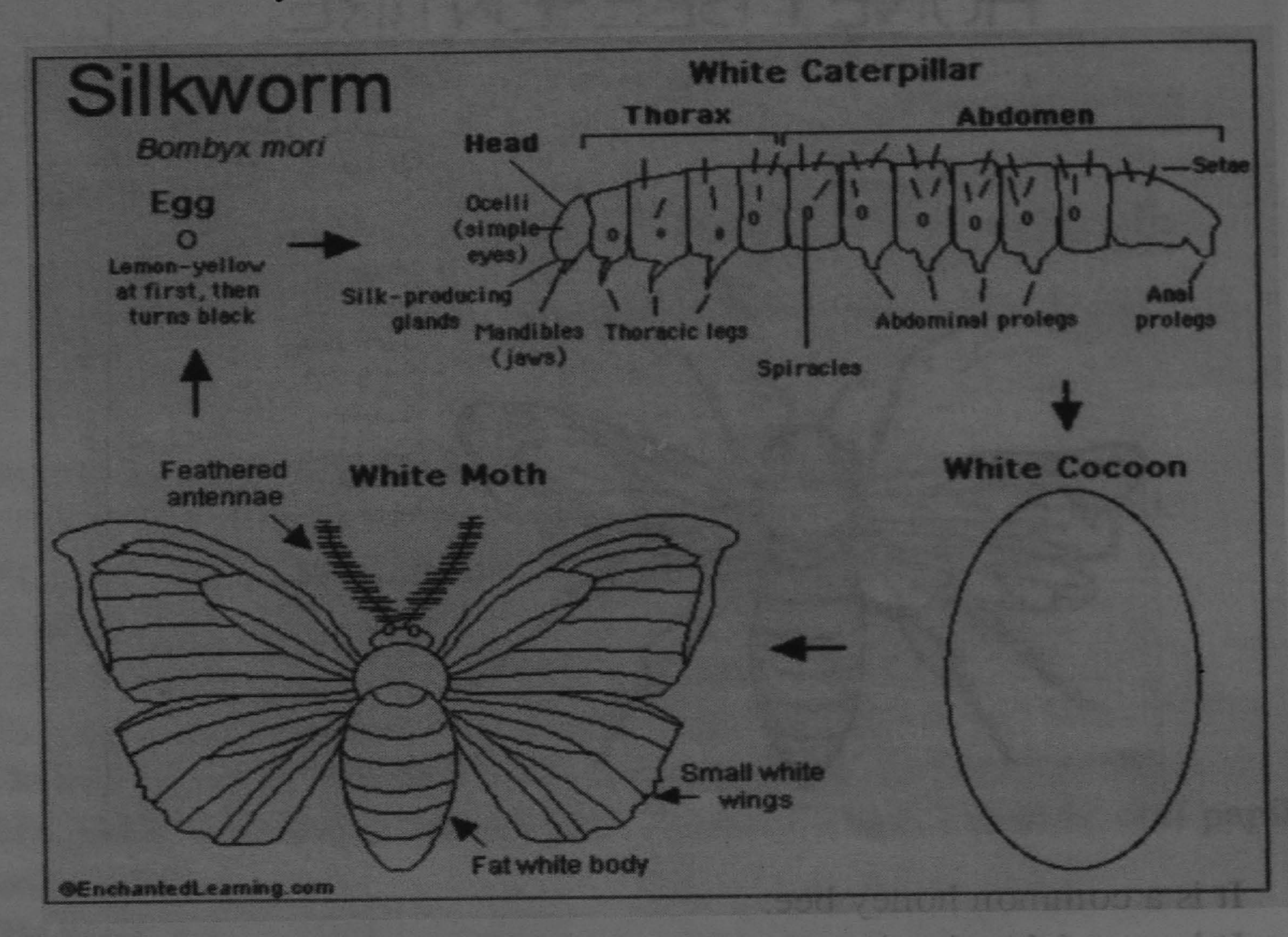
6.6 SILKWORM

Phylum : Arthropoda

Class : Insectea

Order : Lipidoptera

Family : Bombycidae



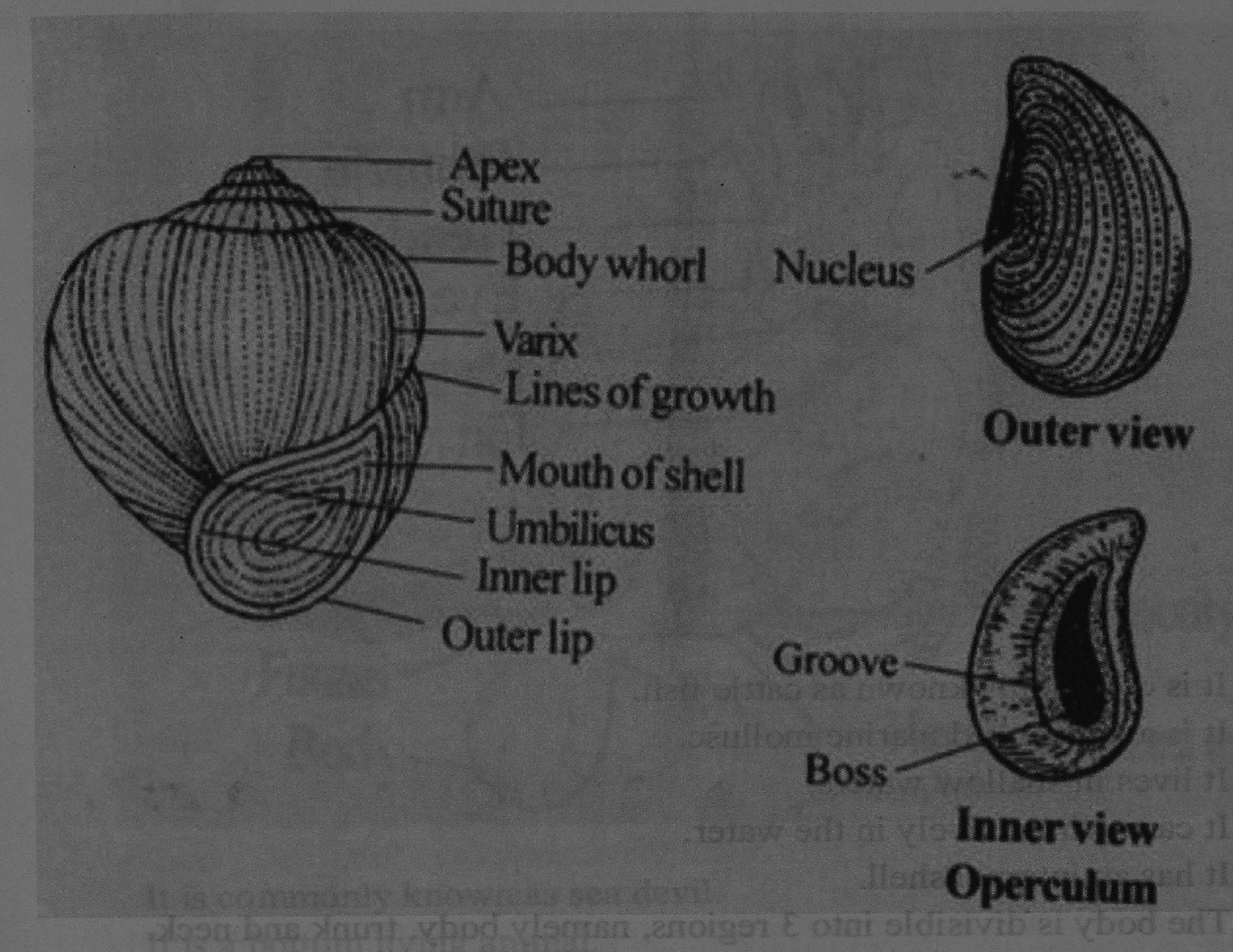
Silkworm is the domesticated animal and it is an economically important insect.
Silkworm is the primary producer of the silk.
95% commercial silk comes from murdering silkworm Bombyx mori.
The body larva is divided into three regions, head, thorax and abdomen.
The head is small, bright brown in colour and it bears the mouth and sense organs.
The three segments forming the thorax are the prothorax, mesothorax and metathorax.
Abdomen is formed by eleven segments.
The caudal plate is present in the last segment of abdomen.
The silk thread of cocoon is secreted by a pair of silk glands.

7. MOLLUSCA- PILA

Phylum : Mollusca

Class : Gastropoda

Order : Pectinibranchiala



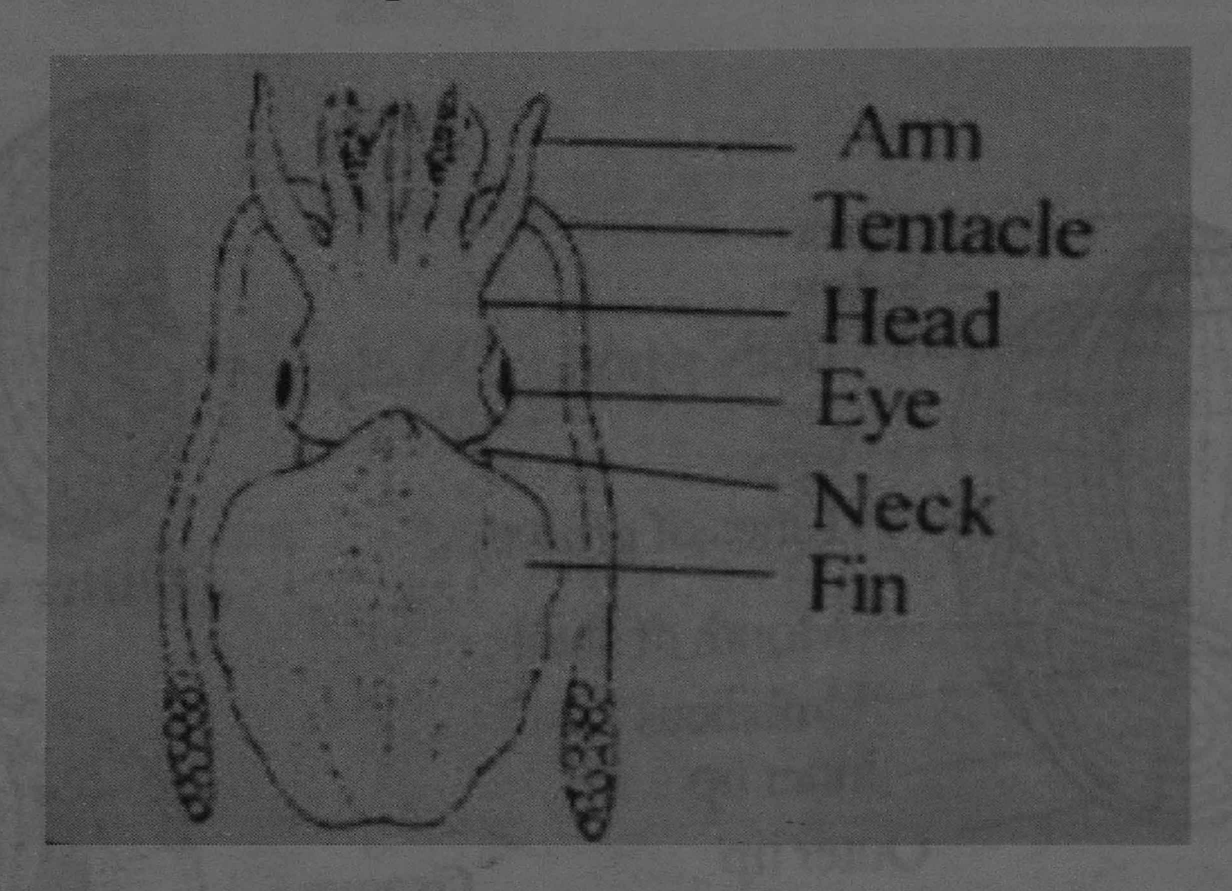
It is commonly known as apple snail.
It lives in ponds, tanks, lake and paddy field.
The body is enclosed in a spirally coiled shell.
It has an opening called shell mouth.
The shell mouth is closed by an operculum.
The body is soft.
The body is divisible into head, foot and visceral mass.
It can feed on aquatic plants.

7. SEPIA

Phylum : Mollusca

Class : Chephalopoda

Order : Decapoda



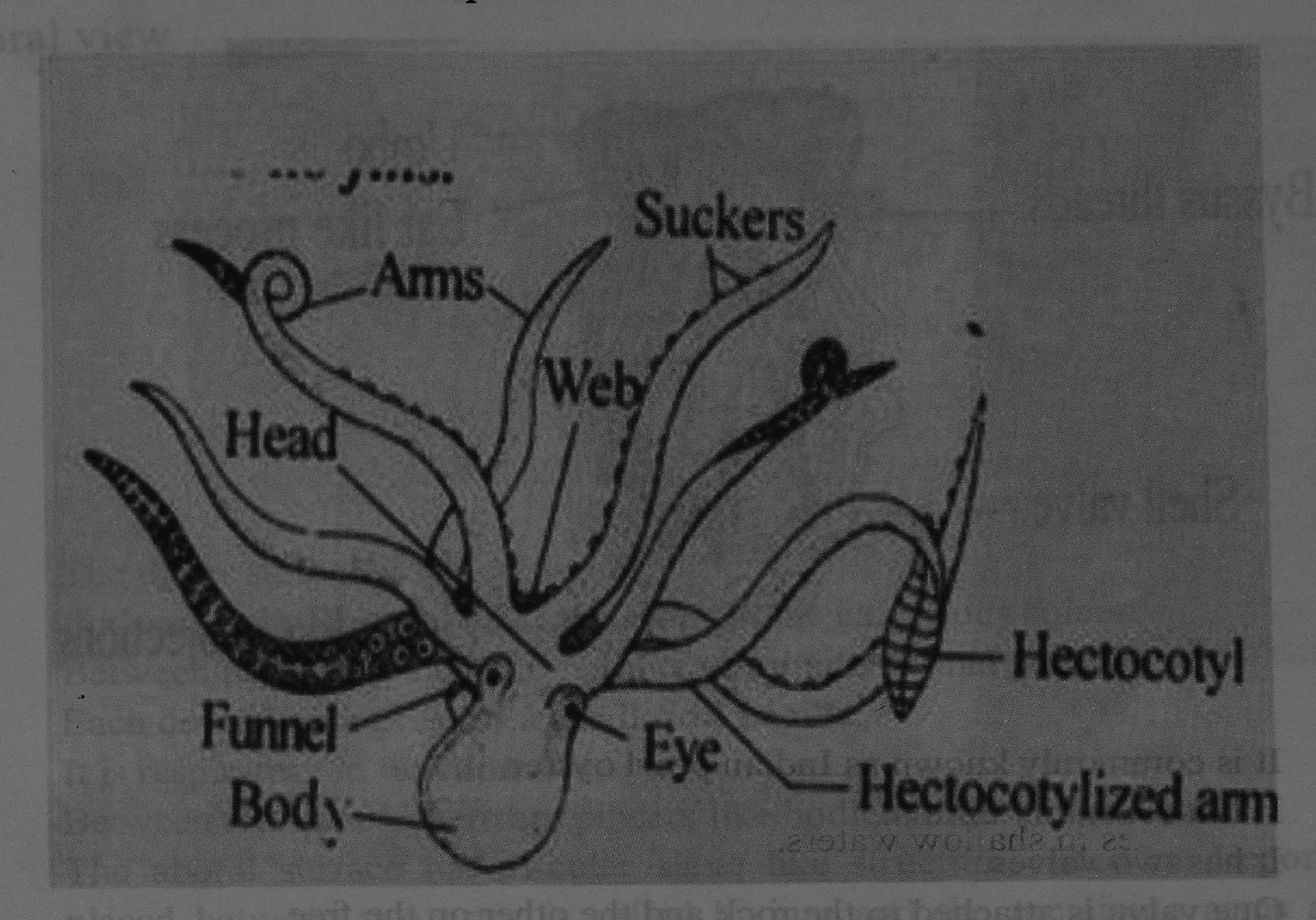
It is commonly known as cattle fish.
It is an advanced marine mollusc.
It lives in shallow waters.
It can swim actively in the water.
It has an internal shell.
The body is divisible into 3 regions, namely body, trunk and neck.
The head possess a pair of eyes and 5 pairs of arms.
The four pairs of arms bear suckers.
In male, there is a left tentacle which is called hectocotylized arm.
The trunk bears lateral fins while the neck contains a funnel.
Its foot is modified into arms and tentacles
An ink gland is present.

OCTOPUS

Phylum : Mollusca

Class : Cephalopoda

Order : Octopoda



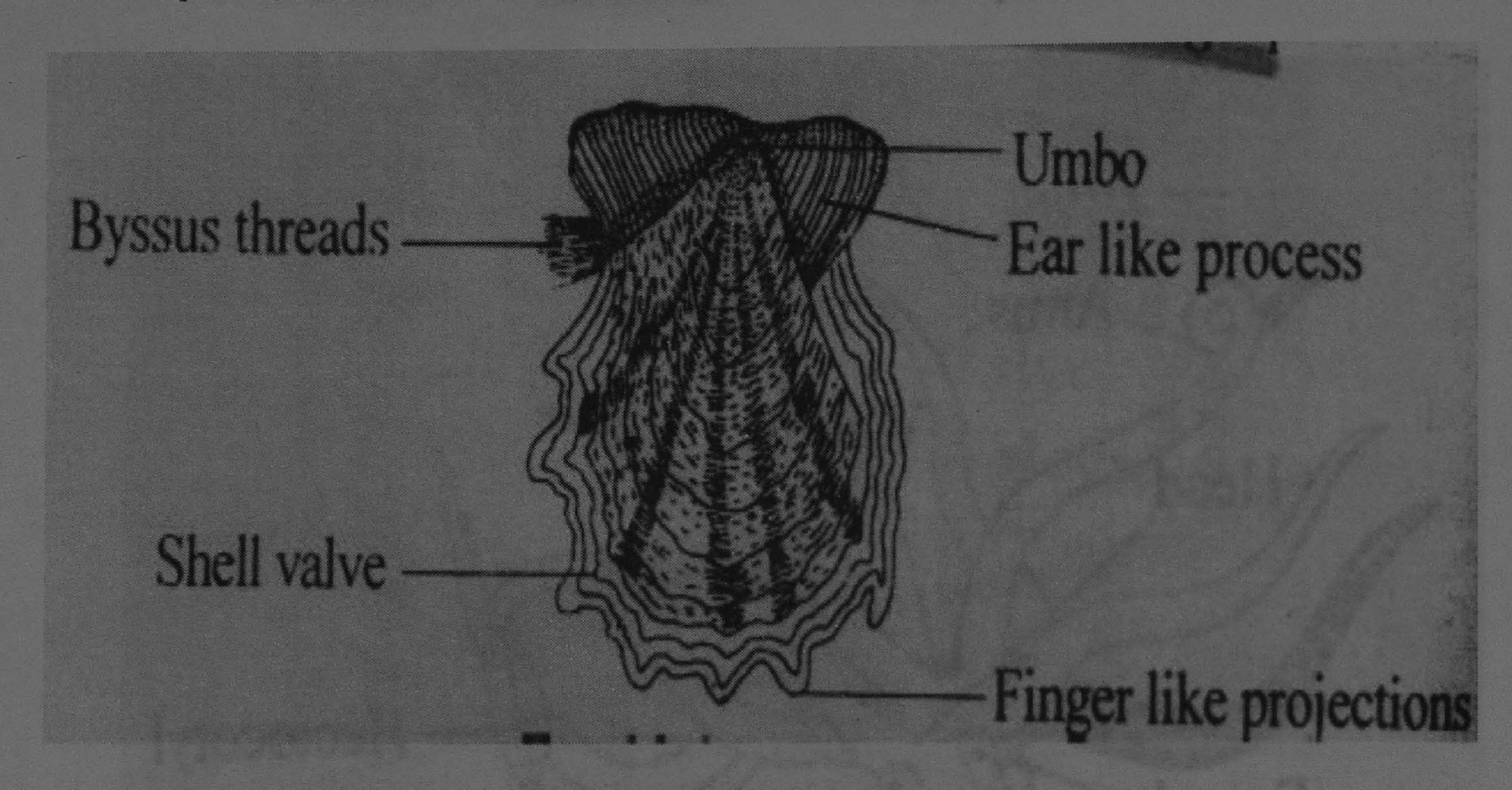
It is commonly known as sea devil.
It is a bottom living animal.
The body is globe like.
It has no fins.
It is a free swimming form.
It has eight tentacles or arms and all are equal in length.
The suckers are sessile.
The margins of the mantle are fused to the body dorsally and laterally.
In male, the third right arm is hectocotylized.

PEARL OYSTER (PINCTADA)

Phylum : Mollusca

Class : Pelecypoda

Order : Pseudolameclibranchiata

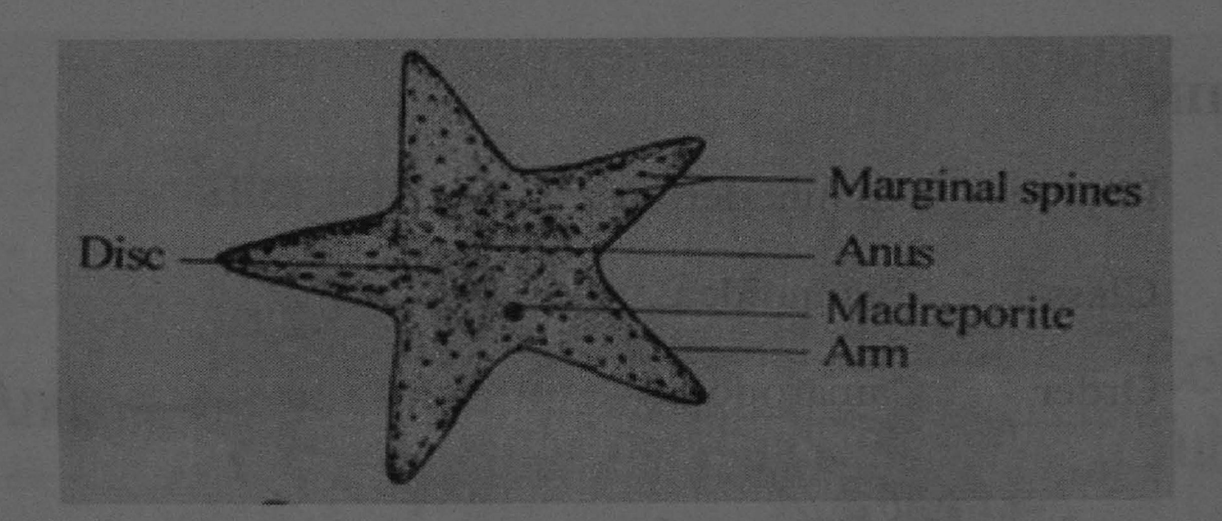


It is commonly known as Indian pearl oyster.
It is a sedentary animal.
It has two valves.
One valve is attached to the rock and the other on the free.
The valves are unequal.
There is a wing like process at the hinge portion.
The foot is small.
There are no siphons.
It produces natural pearls

8. ECHINODERMATA – STAR FISH (ASTERIAS TUBENS)

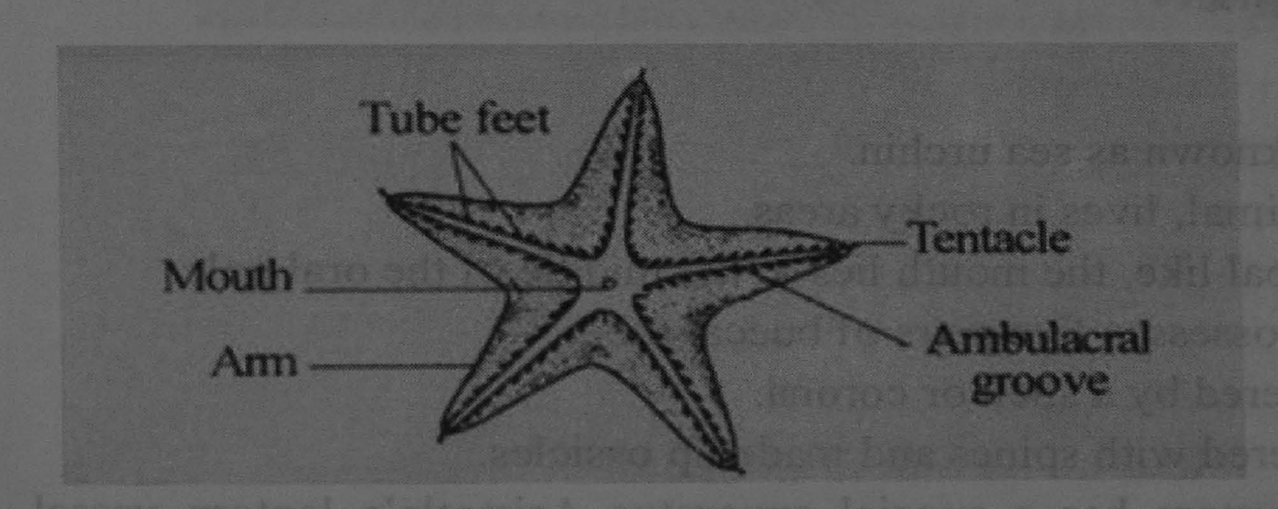
Phylum : Echinodermata
Class : Asteroidea
Order : Forcipulata

Aboral view



The upper surface is called oboral surface.
It is covered with stout and blunt immovable calcarious spines.
Between the spines there are number of minute dermal pores.
Each dermal pore projects a small, soft papilla.
It is respiratory in function.
Between the spines, there are pincers like bodies called pedicellariae.
The aboral surface has circular sieve like structure called madreporite placed between two arms is called bivium and the remaining arms are called trivium.

Oral view



The flat surface is called oral surface.
In the centre of the oral surface, there is a pentagonal structure called mouth.

Five ambulacral grooves arise from the mouth and run towards each arm upto its tip. Each groove has thin walled tubular structures called Tube feet.

It is the organ of locomotion.

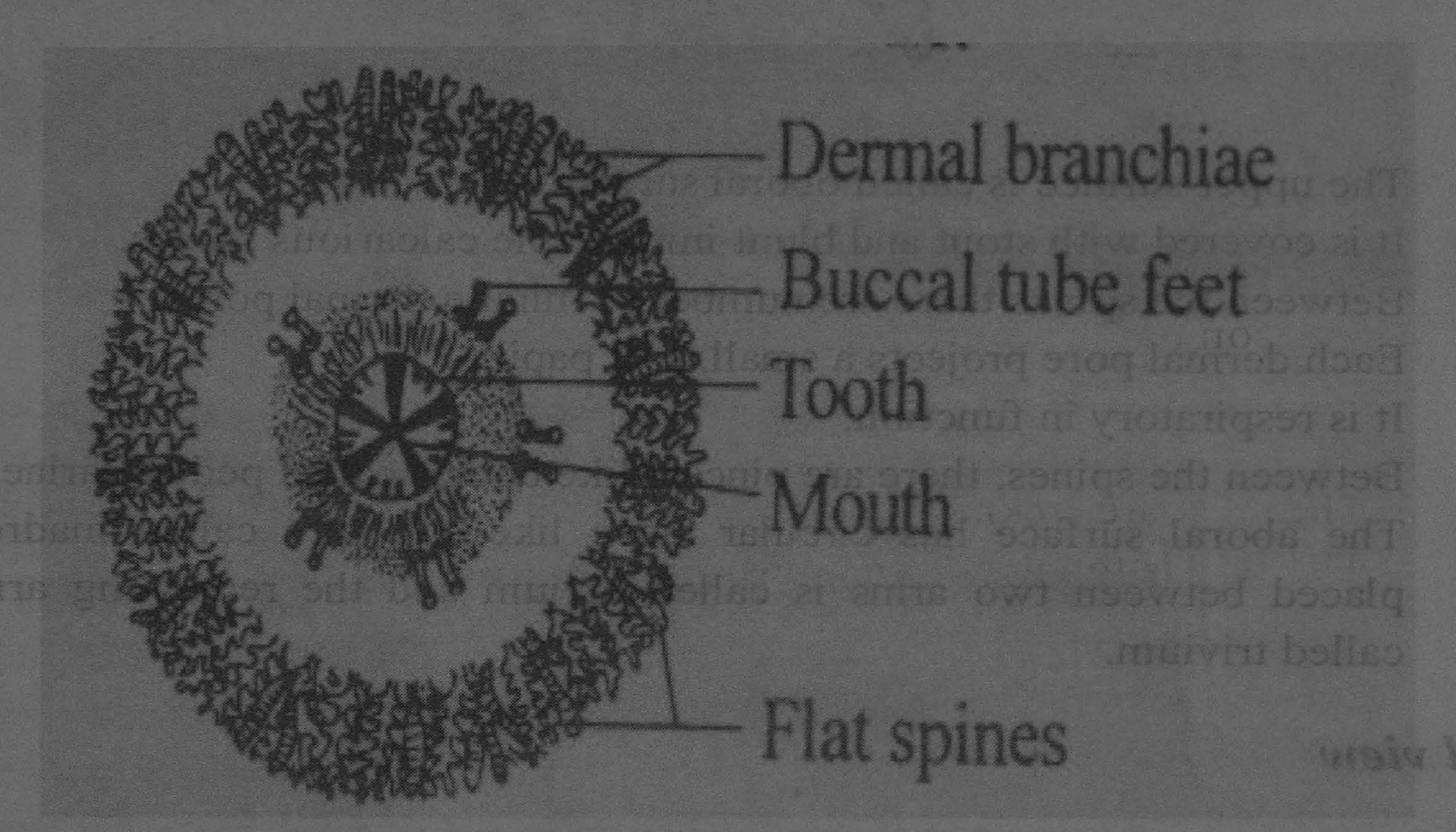
The pedicellariae is used for capturing the prey.

SEA URCHIN

Phylum : Echinodermata

Class : Echinoidea

Order : Camarodonta



It is commonly known as sea urchin.

It is a marine animal, lives in rocky areas.

The body is global like, the mouth lies in the middle of the oral pole.

The peristome possesses five pairs of buccal tube.

The body is covered by a shell or corona.

The shell is covered with spines and made up ossicles.

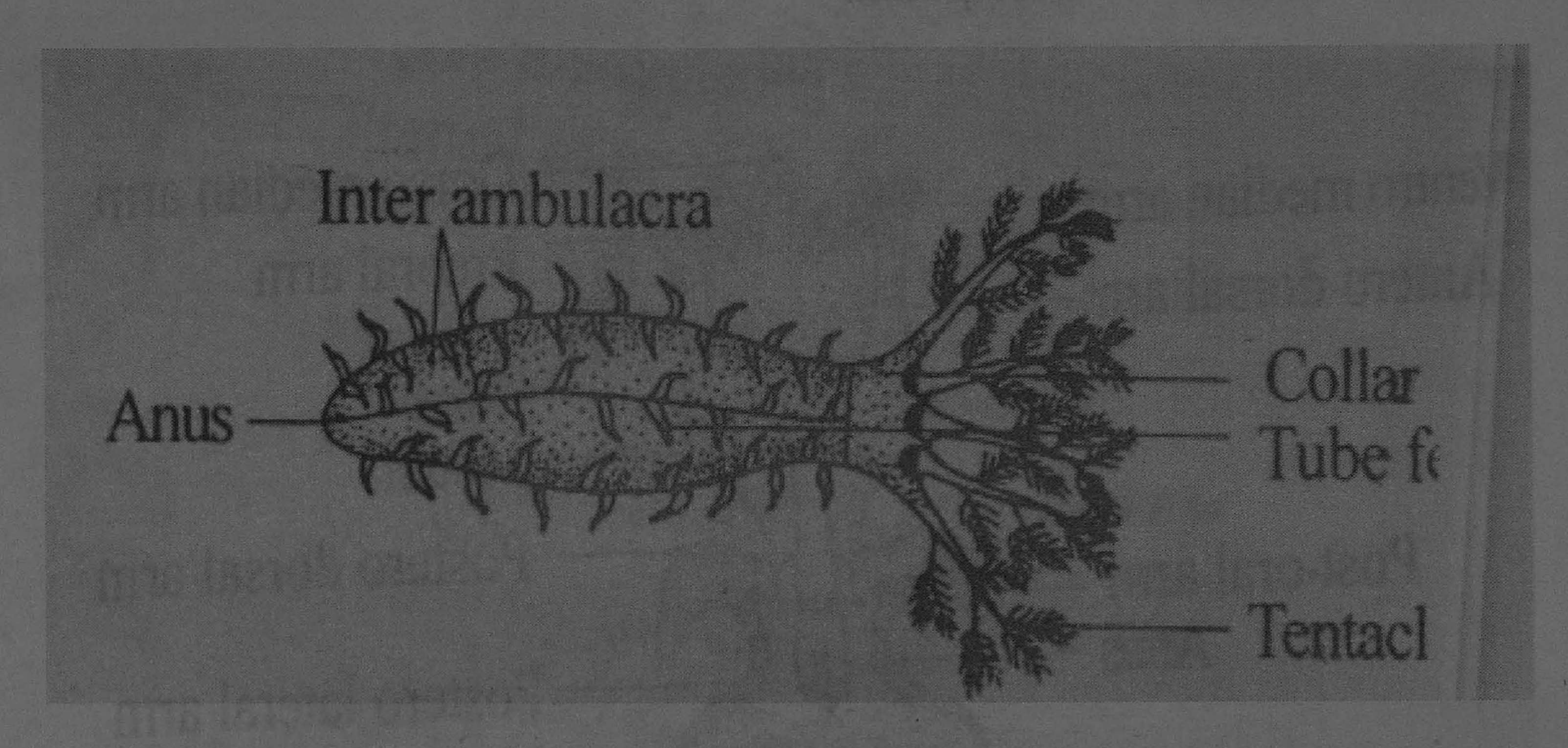
The digestive system has a special apparatus Aristotle's lantern vessel bears tube feet.

SEA CUCUMBER

Phylum : Echinodermata

Class : Holothuroidea

Order : Dendrochirota



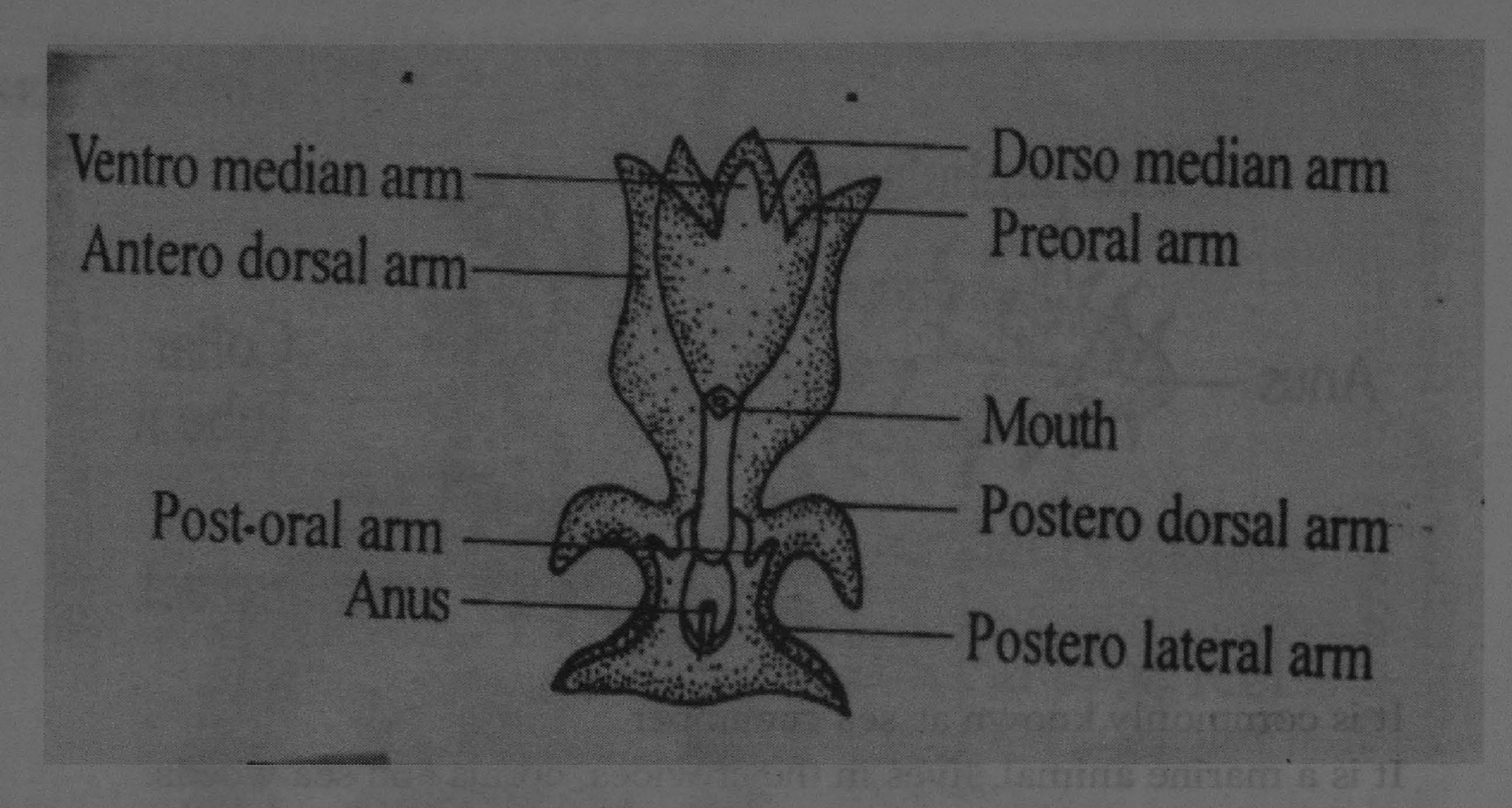
It is commonly known as sea cucumber.
It is a marine animal, lives in the crevices, corals and sea weeds.
The body is elongated, with a anus at the anal end.
The arms are lacking.
The skin is tough and contains spicules.
The mouth is surrounded by branched tentacles.
The tube feet are arranged in ten rows.
There are no pedicellariae.

BIPINNARIA LARVA

Phylum : Echinodermata

Class : Asteroidea

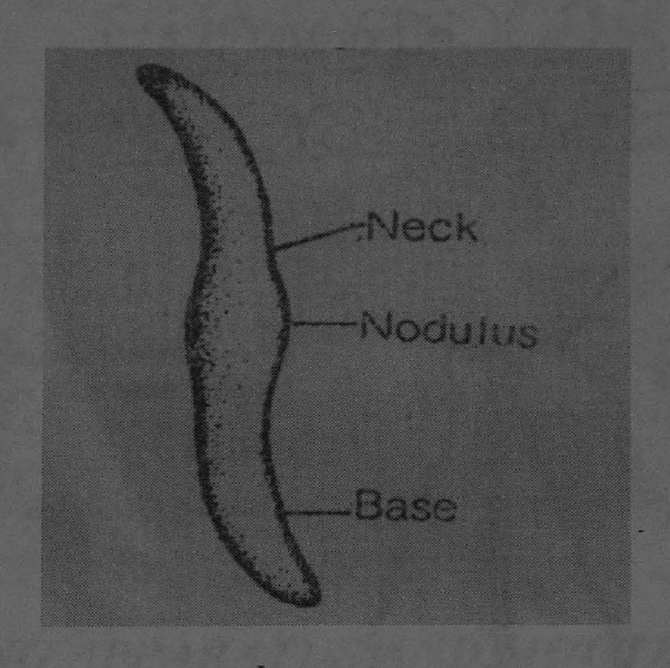
Order : Forcipulata



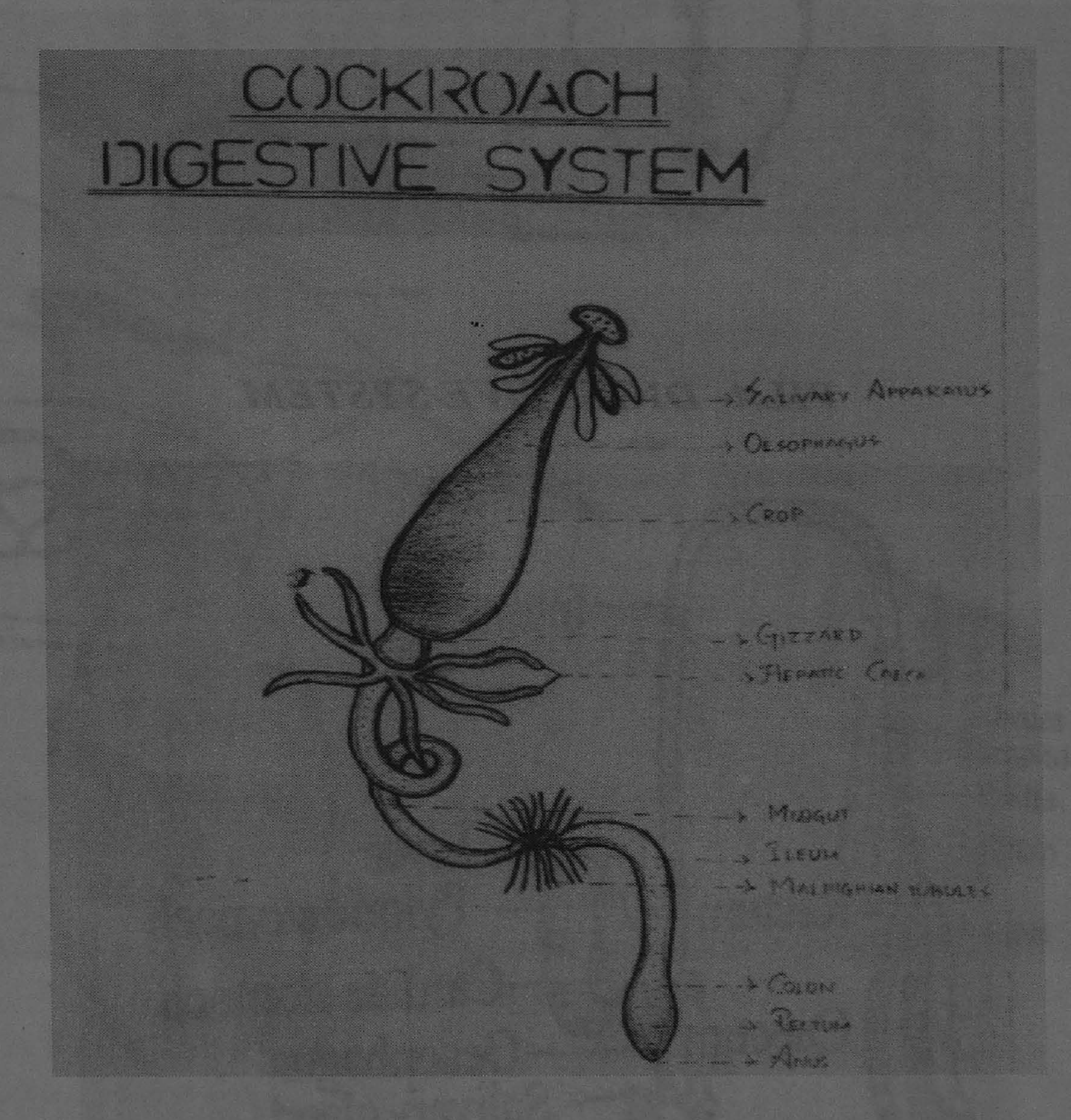
It is the larva of star fish.
It is microscopic, swims freely in the surface of the water.
The alimentary canal is simple with a mouth and an anus.
It is bilaterally symmetrical.
The body is provided with various types of arms.
They are median dorsal arm, median ventral arm, preoral arm, postoral, antero dorsal, postero dorsal arms and postero lateral arms.
The arms possess ciliated bands.
They help in locomotion.

DISSECTION CHARTS

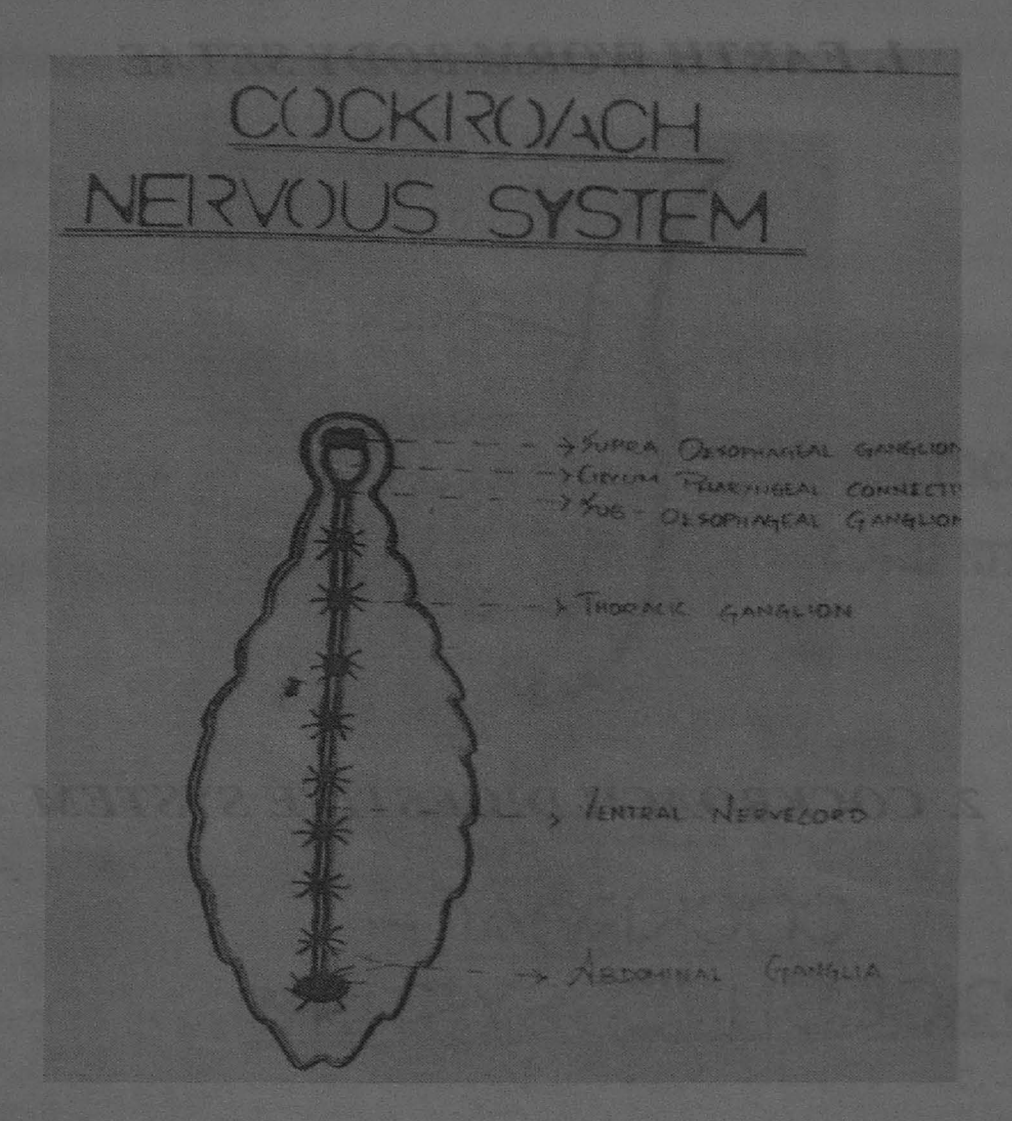
1. EARTH WORM BODY SETAE



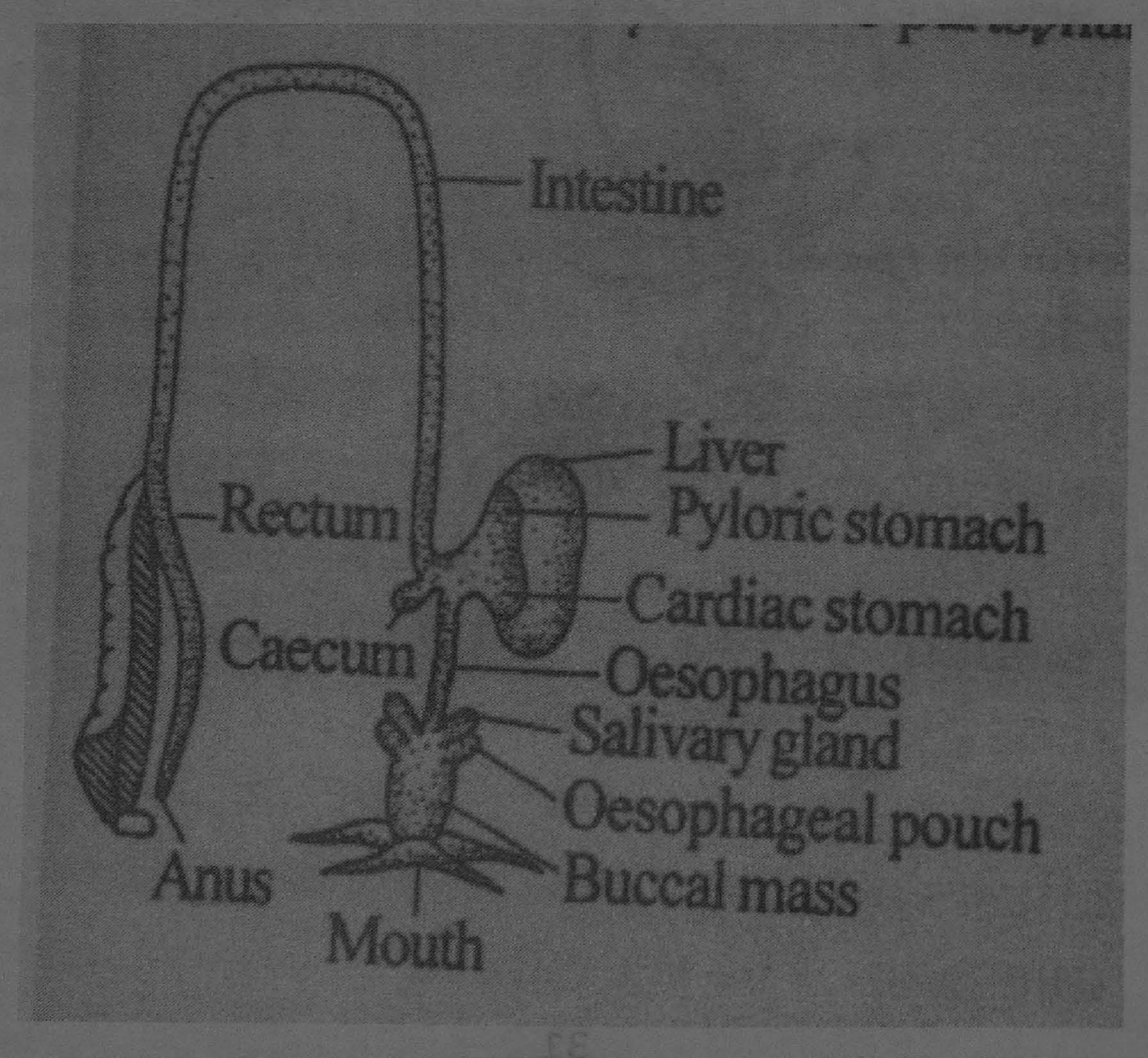
2. COCKROACH DIGESTIVE SYSTEM



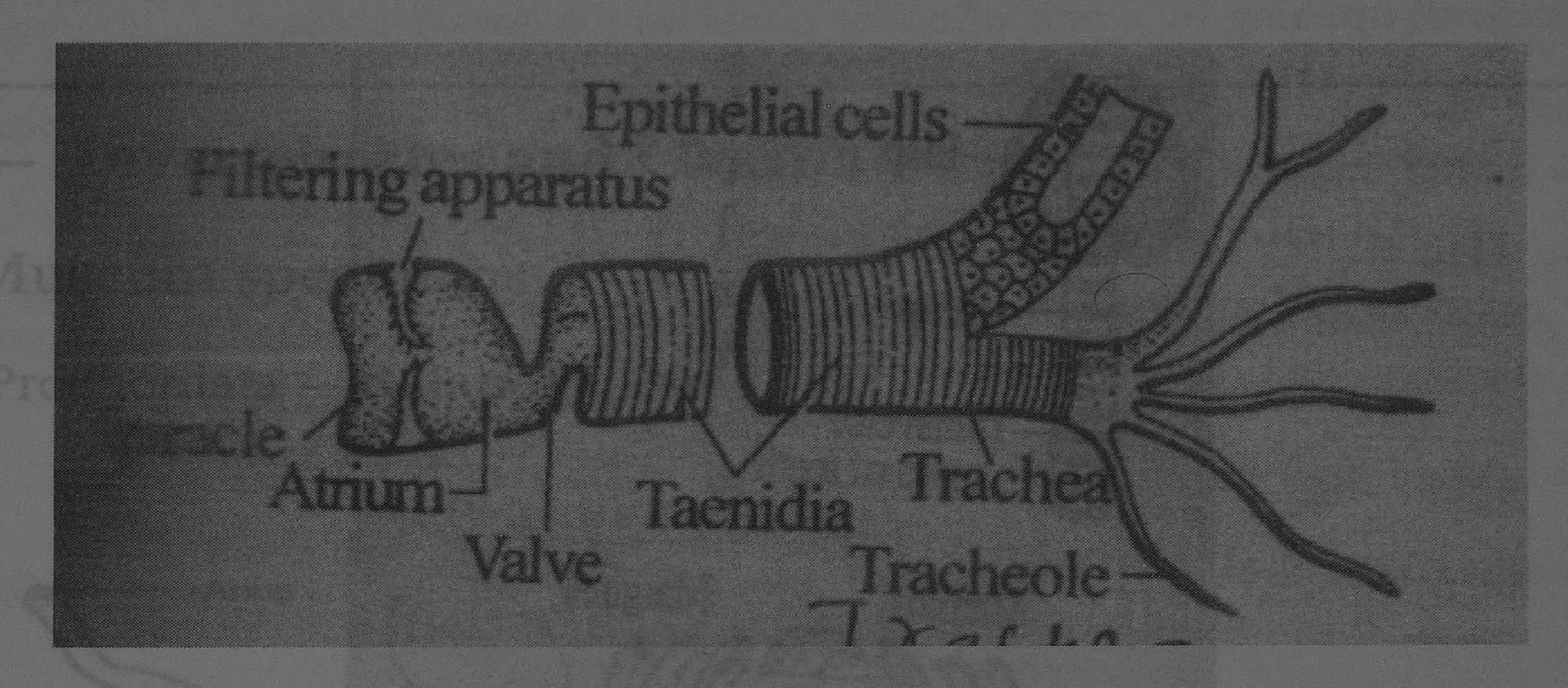
3. COCKROACH NERVOUS SYSTEM



PILA- DIGESTIVE SYSTEM

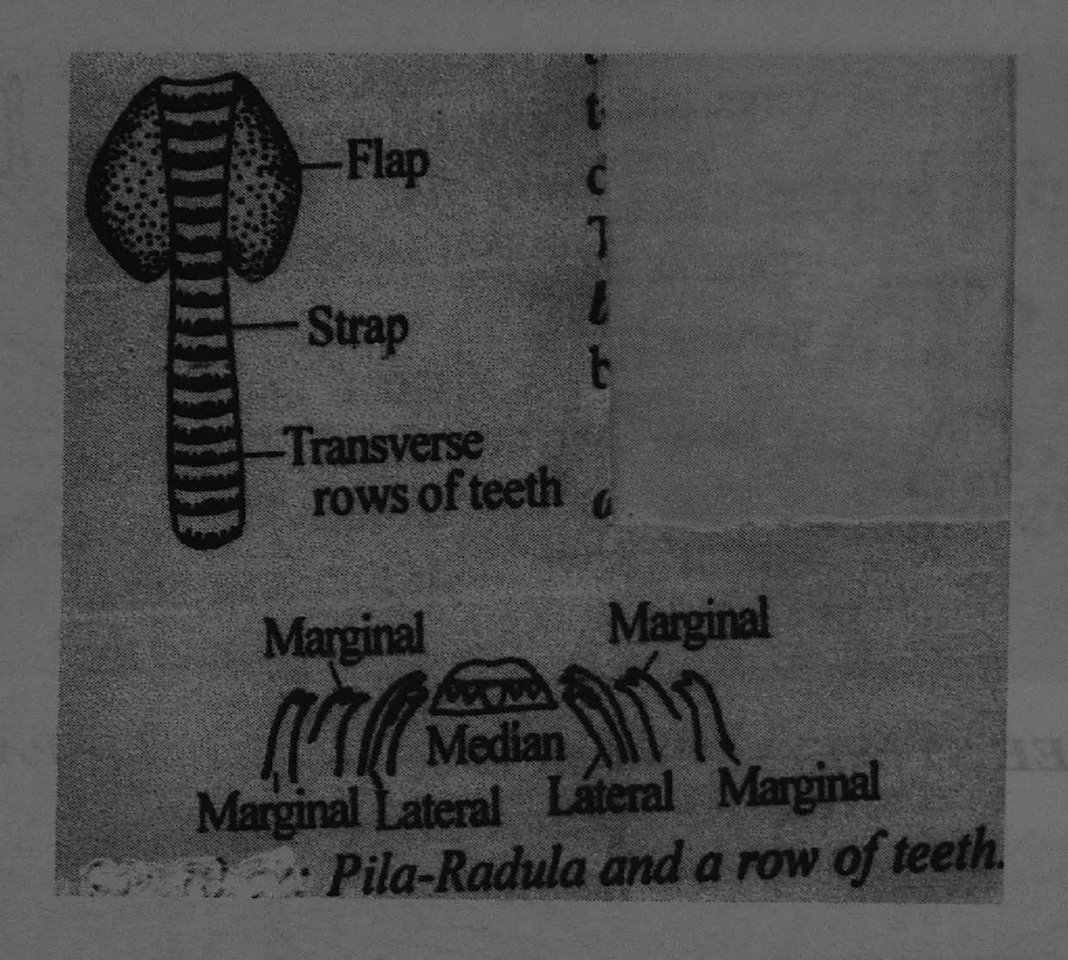


COCKROACH TRACHEA



HONEYBEE STING APPARATUS AND MOUTH PARTS

RADULA



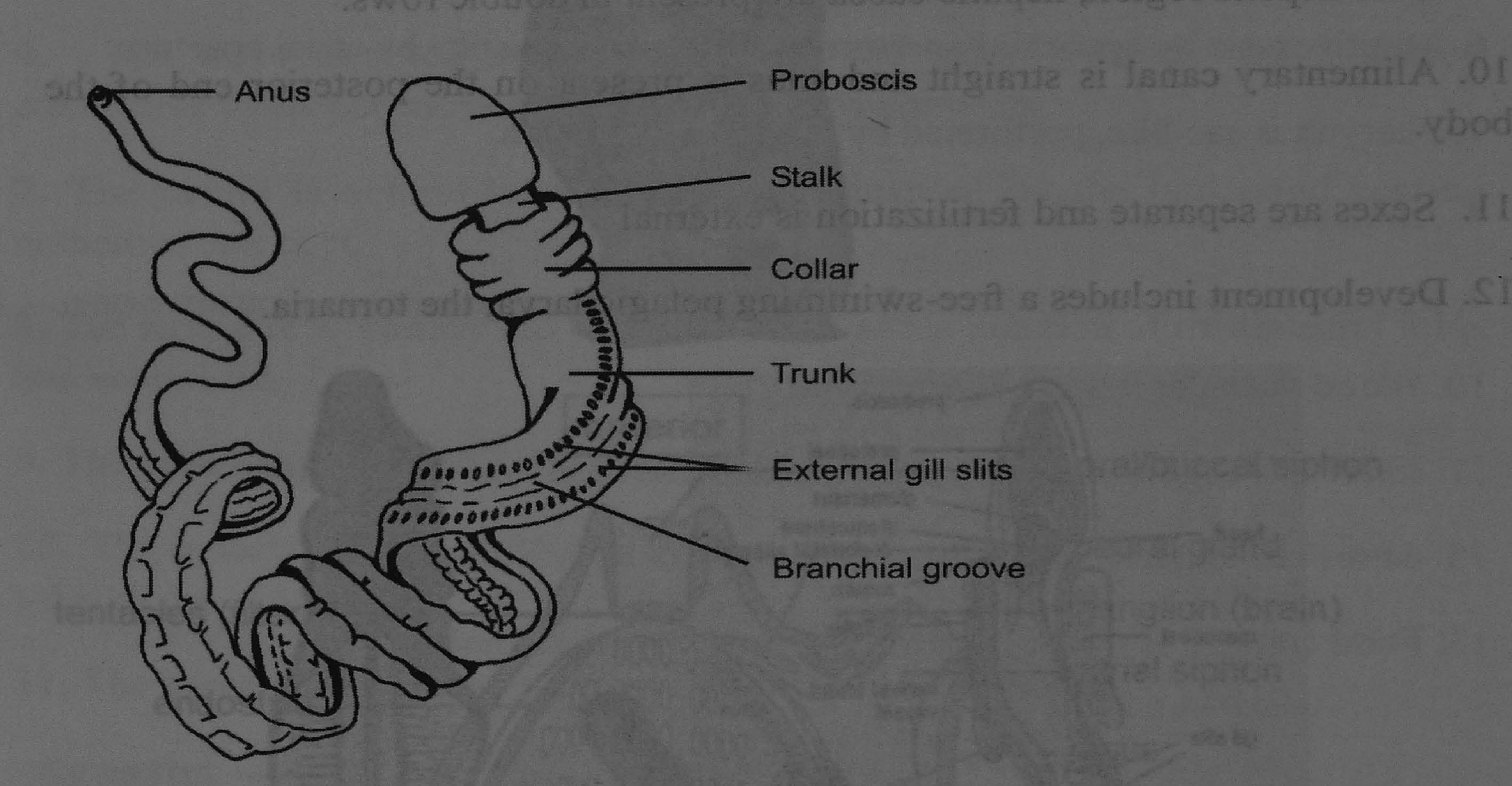
Pila-Radula and a row of teeth.

Paper -- III Practical-I

--- Invertebrates and Chordates

Museum specimens

Prochordata -- **Balanoglossus**



1. Balanoglossus is commonly known as acorn worm.

2. It is a marine burrowing worm like animal.

3. Body is soft and cylindrical having ciliated surface reaching a length of 10-50 cm.

4. The body is divisible into short conical proboscis, collar and a long trunk.

5. Proboscis has a thick muscular walls and its cavity proboscis coelom opens to the exterior by a proboscis pore.

6. Collar is short, muscular cylinder-like, enclosing a pair of coelomic cavities (collar coelom) opening by a pair of collar pores on the dorsal surface.

7. Trunk is superficially ringed. It is divisible into anterior branchio-genital region, a middle hepatic region and a posterior abdominal region.

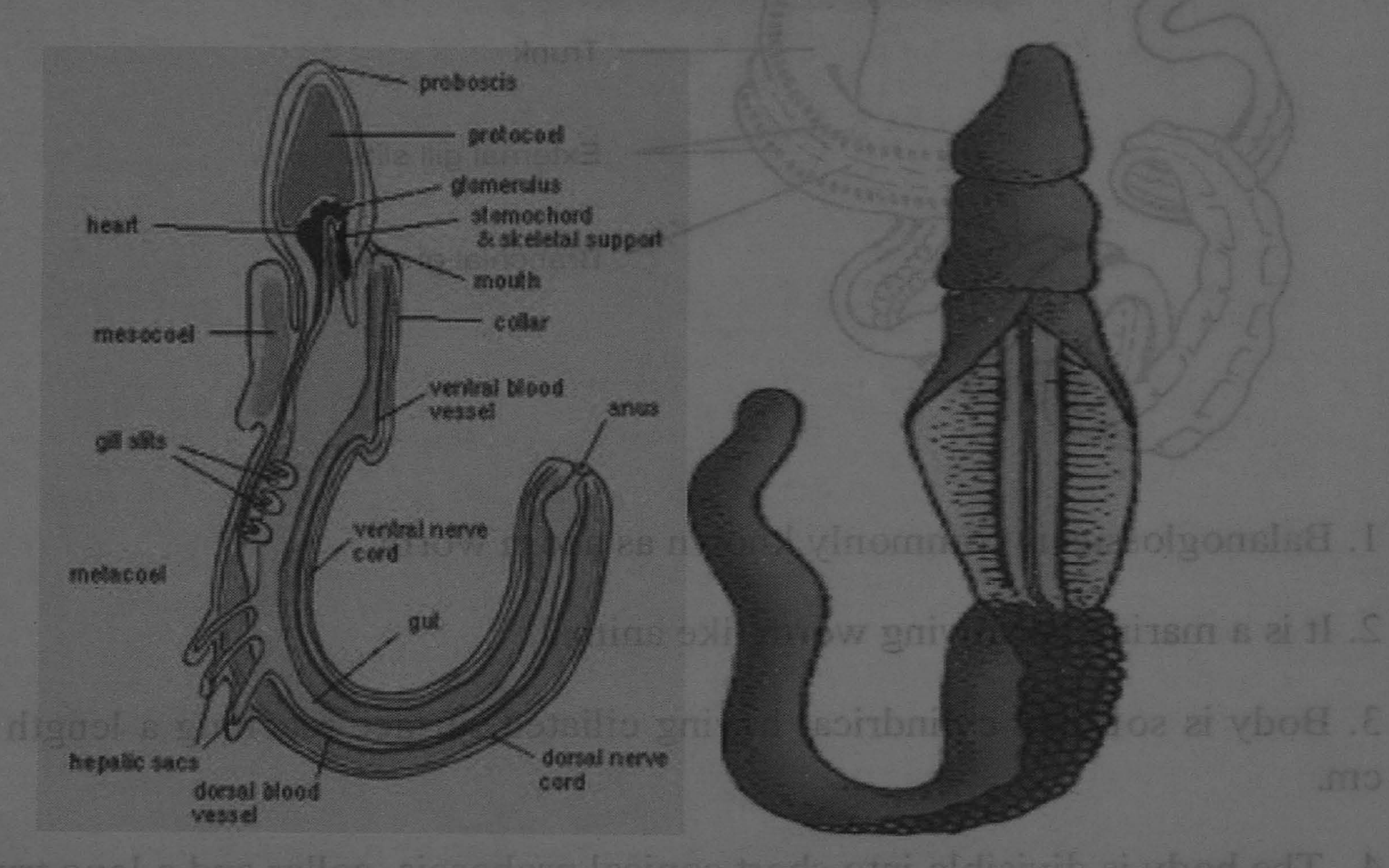
8. In the branchio-genital region are present a pair of genital wings formed by internal gonads and a branchial groove having numerous pired gill-slits arranged into two rows.

9. In the hepatic region, hepatic cacea are present in double rows.

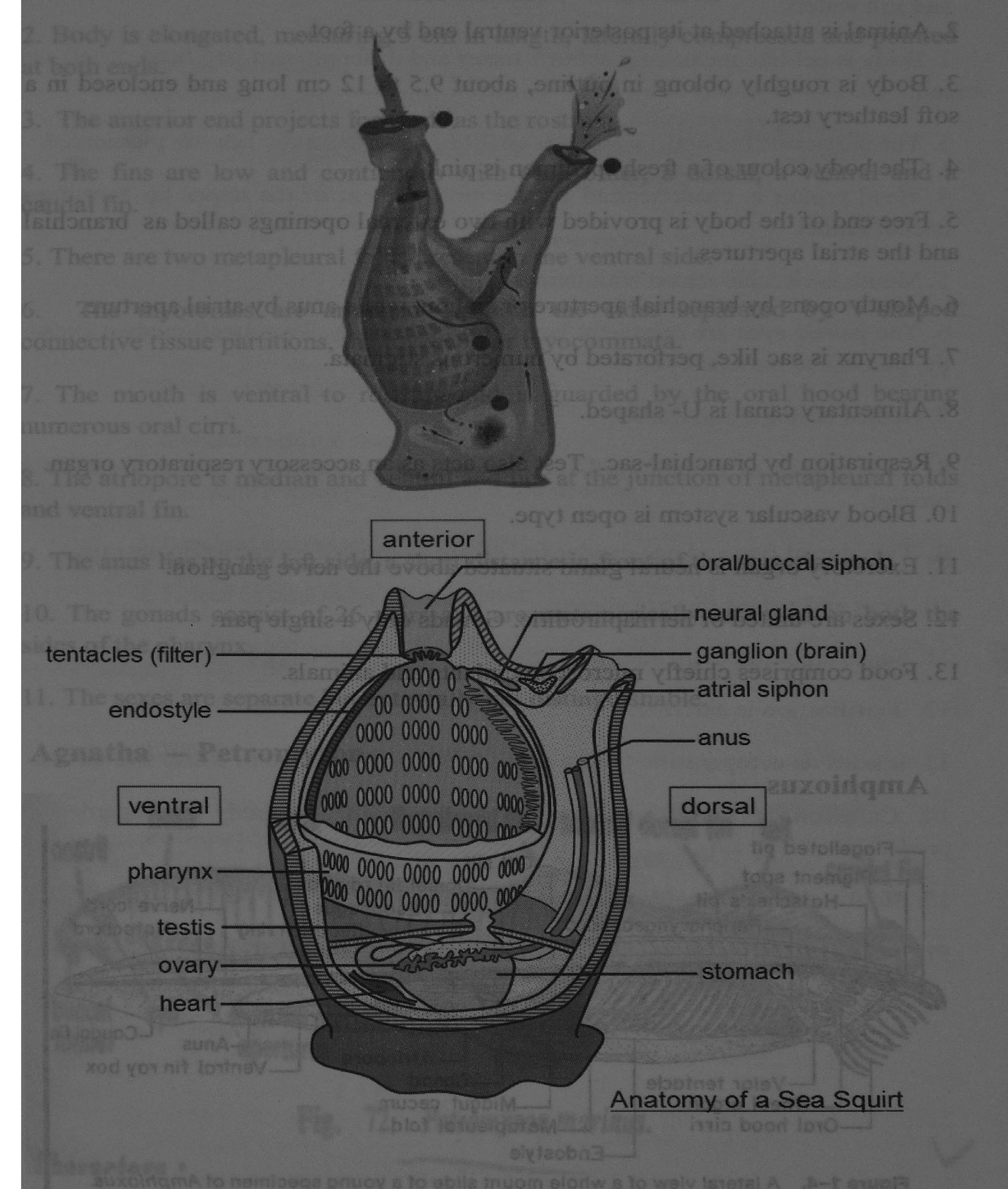
10. Alimentary canal is straight and anus is present on the posterior end of the body.

11. Sexes are separate and fertilization is external

12. Development includes a free-swimming pelagic larva, the tornaria.



2. Herdmania - Ascidian



Anatomy of a Sea Squirt

1. Hermania pallid is a solitary marine form.

2. Animal is attached at its posterior ventral end by a foot.

3. Body is roughly oblong in outline, about 9.5 to 12 cm long and enclosed in a soft leathery test.

4. The body colour of a fresh specimen is pink.

5. Free end of the body is provided with two external openings called as branchial and the atrial apertures.

6. Mouth opens by branchial aperture or siphon, while anus by atrial aperture.

7. Pharynx is sac like, perforated by numerous stigmata.

8. Alimentary canal is U- shaped.

9. Respiration by branchial-sac. Test also acts as an accessory respiratory organ.

10. Blood vascular system is open type.

11. Excretory organ is neural gland situated above the nerve ganglion.

12. Sexes are united or hermaphroditic. Gonads only a single pair.

13. Food comprises chiefly microscopic plants and animals.

Amphioxus

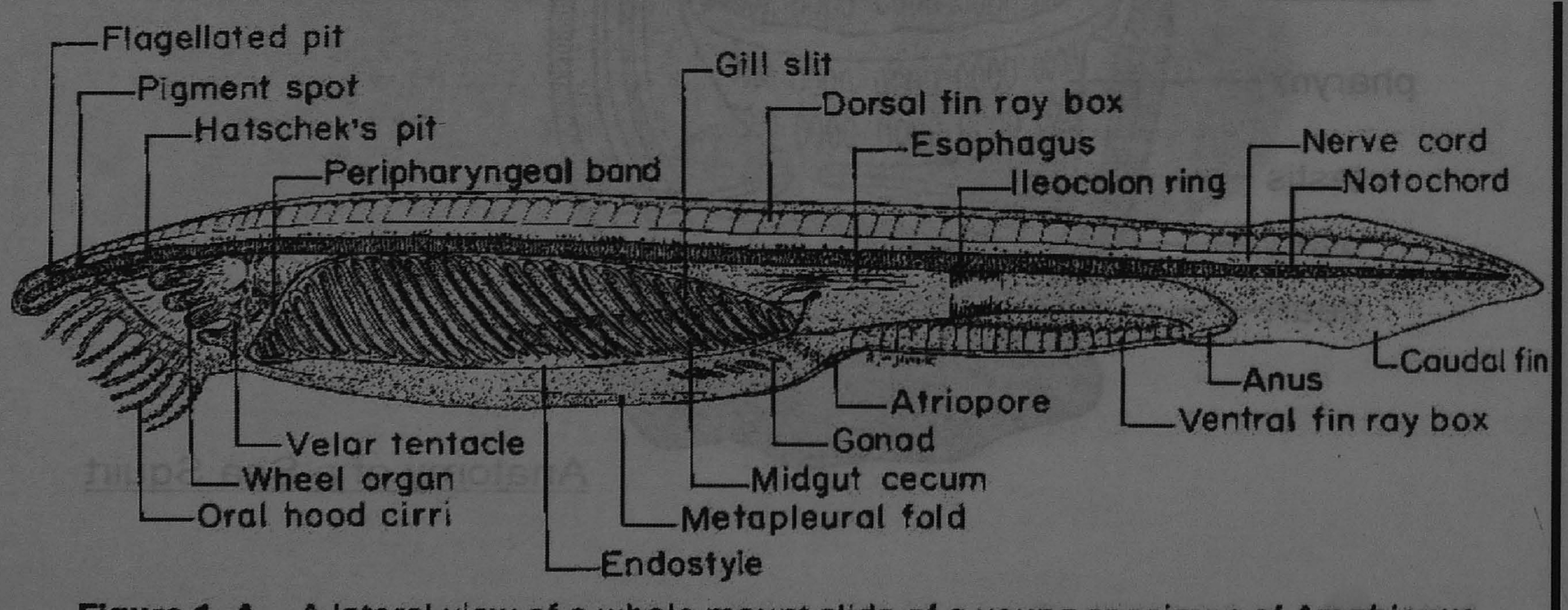


Figure 1–4. A lateral view of a whole mount slide of a young specimen of *Amphioxus.*

1. Amphioxus is a fish-like burrowing marine animal.

2. Body is elongated, measuring 5 cm in length, laterally compressed and pointed at both ends.

3. The anterior end projects forwards as the rostrum.

4. The fins are low and continuous with each other, a dorsal, a ventral and a caudal fin.

5. There are two metapleural folds present in the ventral side.

6. The myotomes are arranged on both the sides separated by V-shaped connective tissue partitions, the myosepa or myocommata.

7. The mouth is ventral to rostrum and is guarded by the oral hood bearing numerous oral cirri.

8. The atriopore is median and ventral and lies at the junction of metapleural folds and ventral fin.

9. The anus lies on the left side, a short distance in front of the posterior end.

10. The gonads consist of 26 pairs and are metamerically arranged on both the sides of the pharynx.

11. The sexes are separate but externally not distinguishable.

Agnatha -- Petromyzon

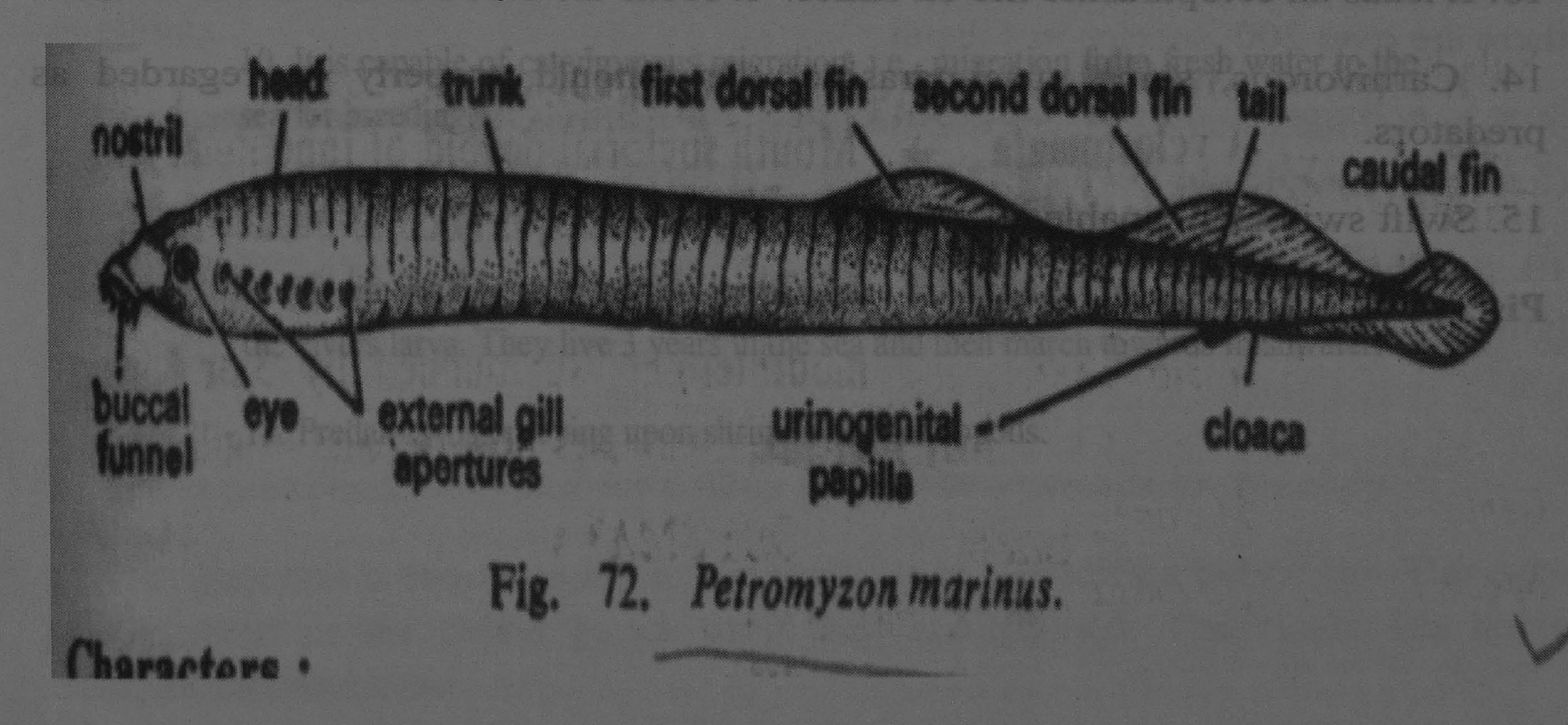


Fig. 72. *Petromyzon marinus.*

Characters :

1. Petromyzon is commonly known as lamprey or lamper eel and found in fresh and salt waters.

2. Body is eel-like measuring about 1 meter and differentiated into head, trunk and tail.

3. The surface of the body is smooth and slimy and generally heavily pigmented.

4. Head region is characterized by the development of the upper lip forming a buccal funnel.

5. Mouth is circular armed with numerous horny teeth.

6. The paired eyes are relatively large and functional. Two small median eyes— the pineal and parietal eyes.

7. Nostril is single and dorsal.

8. Seven pairs of external gill-apertures and well-developed branchial-basket is present.

9. Two dorsal fins and one caudal fin, all are supported by cartilaginous rays.

10. Jaws and paired fins are absent.

11. Sexes are separate in adults and there is only single large gonad.

12. Fertilization is external.

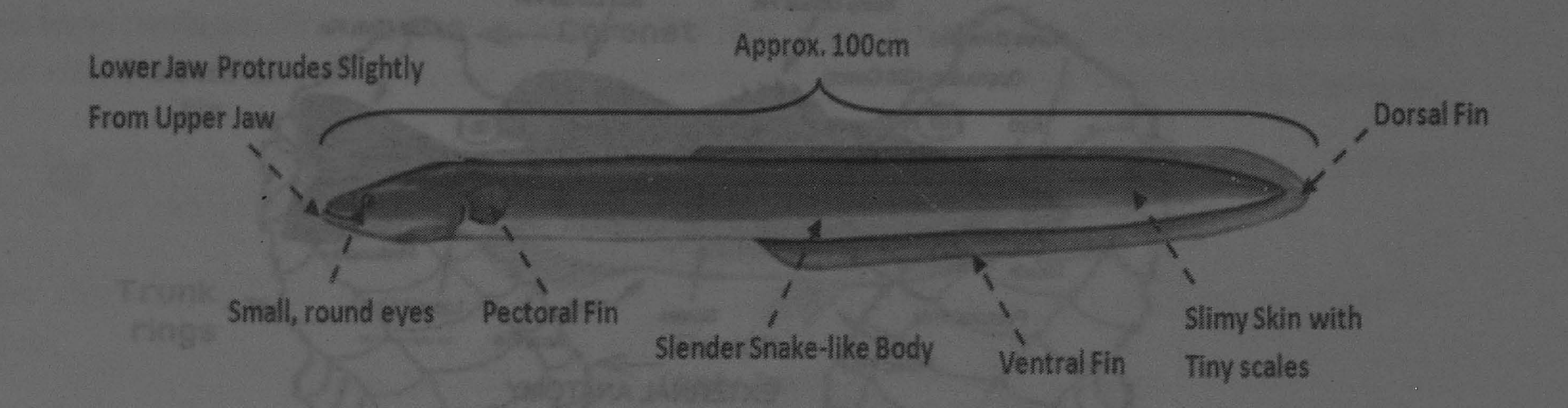
13. It leads an ectoparasitic life on fishes. It sucks the blood of fishes and turtles.

14. Carnivorous, some quasi-parasitic, they should properly be regarded as predators.

15. Swift swimmer capable of over-taking slower preys.

Pisces

Anguilla (Eel)



1. Anguilla is commonly known as eel.

2. Body is elongated, cylindrical and snake-like.

3. It measures upto one meter in length.

4. The colour is brown on the back and yellowish below.

5. Dorsal and anal fins are long and narrow.

6. Pectoral fin small and pelvic fin is absent.

7. Tail is long and caudal fin is quite large.

8. Fins are suppored by rays, spines being absent.

9. Gill-opening is narrow and minute.

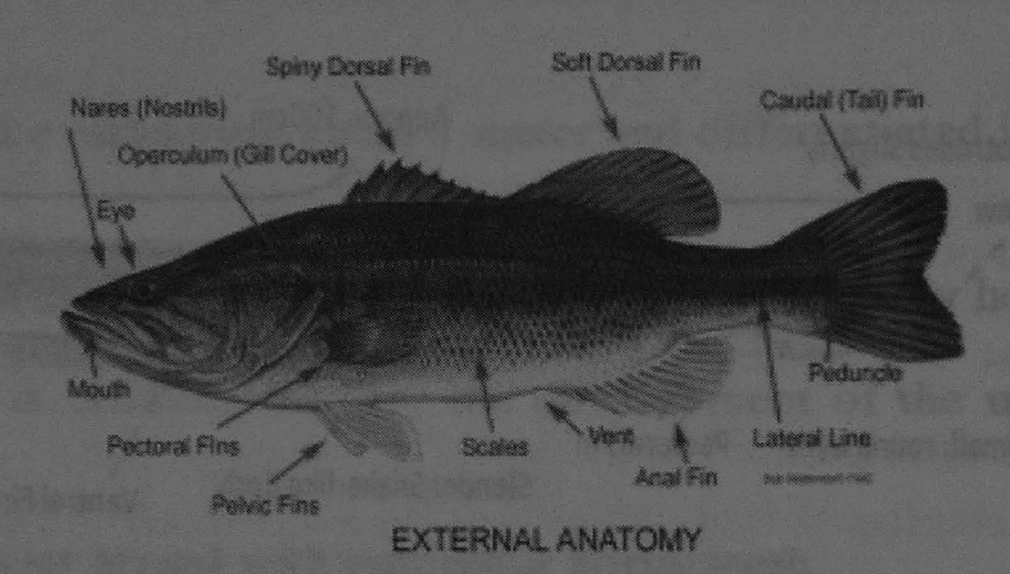
10. It is capable of catadromous migration, i.e., migration from fresh water to the sea for breeding.

11. After spawing both the male and female die in the sea.

12. Its life history includes two larval forms, namely the leptocephalus larva and the elvers larva. They live 3 years in the sea and then march towards freshwater.

13. Predatory fish preying upon shrimps and gastropods.

Tilapia mossambicus



1. Common name is Tilapia.

2. Fish body is laterally compressed.

3. Dorsal fin with 15 spiny rays and 12 soft rays.

4. Anal fin with 11 soft rays, caudal-sub truncate.

5. Pelvic thoracic with one spine.

6. Each scale with a dark centre.

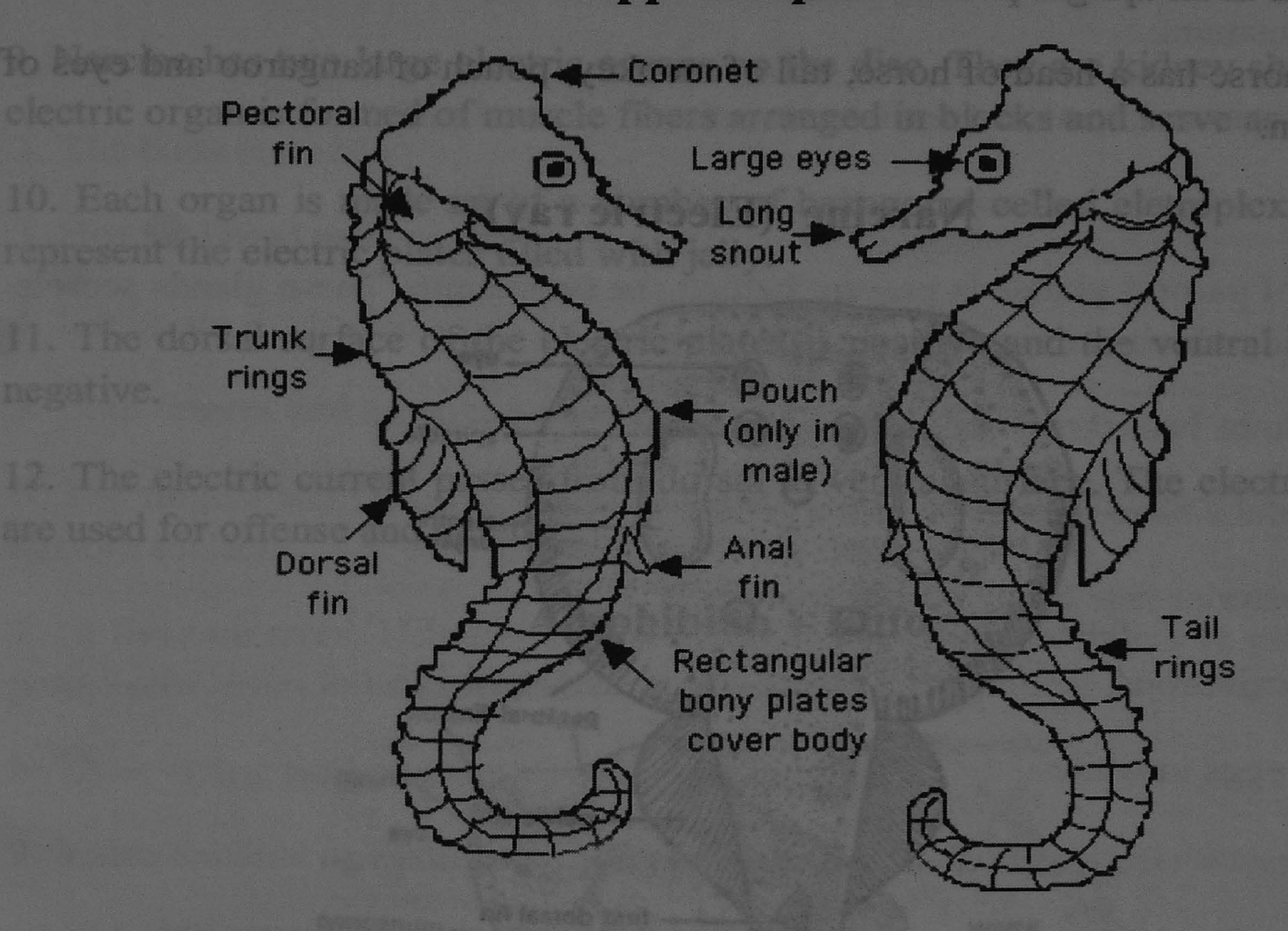
7. Sexual dimorphism : Male is larger than female and possesses a dark olive green body and deep-red fins. Female has two orifices in genitalia as against one in the male.

8. Exotic (from Africa) fresh water fish found in inland waters of India. In Africa there are over 200 species in Tilapia.

9. Eurythermal (8 to 42 c), euryhaline (upto 7.5 percent) and pH tolerance range (5 to 11), can tolerate low 0_2 level as low as 0.1ppm.

10. Prolific breeder. It exhibits parental care – the fertilized eggs are carried by the female till hatching.

Hippocampus



1. Hippocampus is commonly called as sea horse. It is a bony fish. It is a marine fish.

2. The body consists of a head, trunk and tail. The body is covered by dermal scutes.

3. Body marked with circular and transverse ridges on which there are bony swellings.

4. The head is like that of a horse. The head contains a rostrum, a mouth, a pair of eyes and a pair of operculum. The rostrum is tubular.

5. The mouth is located at the terminal end of the rostrum.

6. The trunk bears a pairs of pectoral fins, a dorsal fin and a brood pouch (only in male).

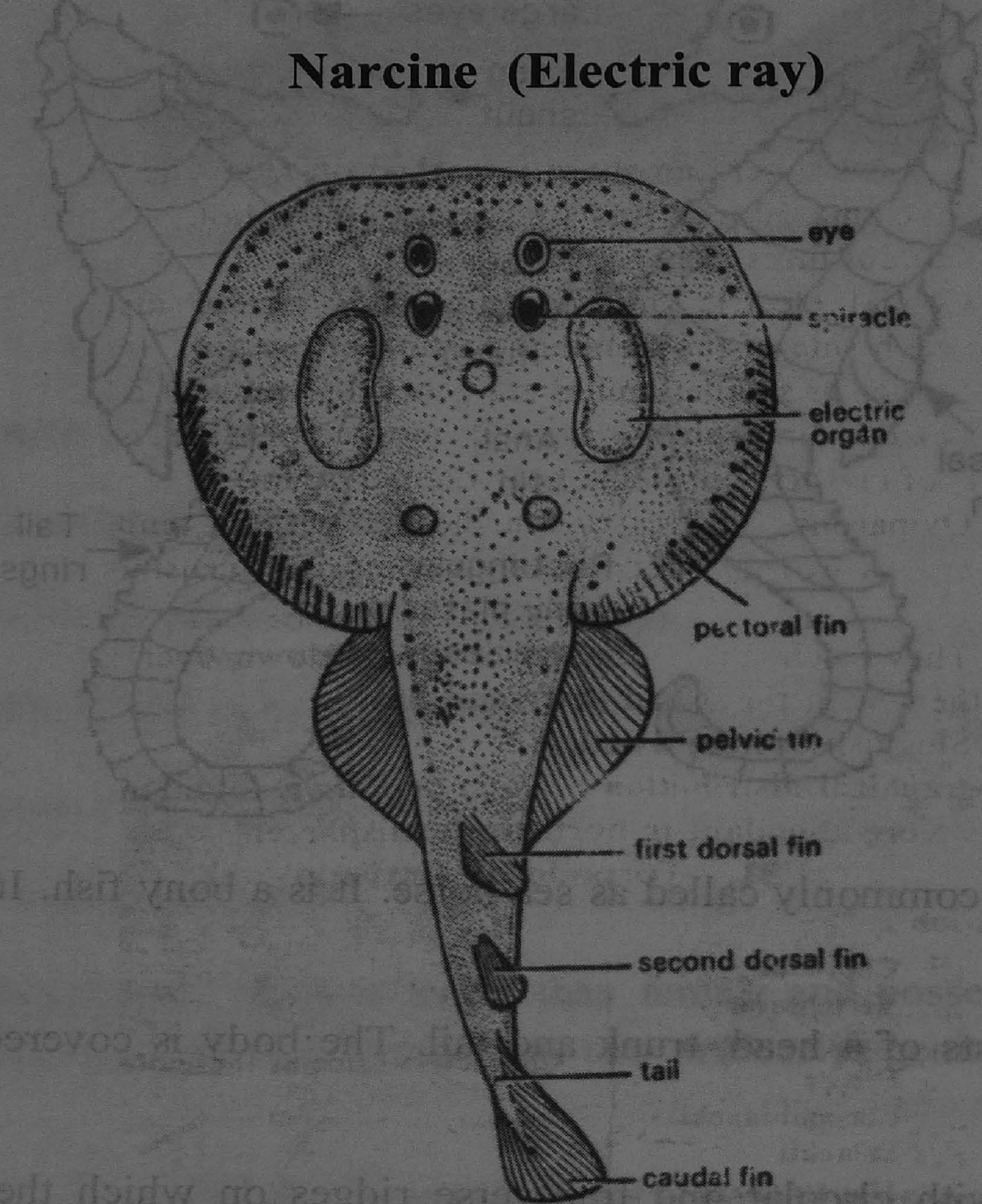
7. Tail is prehensile and used for coiling round the seaweeds for mimicry.

8. The male has a brood pouch in the trunk. It is a modified pelvic fin. The eggs are retained in the brood pouch until they are hatched. Thus male sea horse exhibits parental care.

9. It swims in an upright position. It is carnivorous.

10.. Sea horse has a head of horse, tail of monkey, pouch of kangaroo and eyes of chameleon.

Narcine (Electric ray)



1. Narcine is commonly called us electric ray.

2. It is marine cartilaginous fish.

3. The body consists of a head, a trunk and a tail. The head is disc-shaped and dorsoventrally flattened. The pectoral fin is extended forward to form the disc.

4.The skin is smooth without scales.

5. Mouth is ventral. Eyes are dorsal. Two spiracles are present behind the eyes.

6. Gill slits are ventral.

7. The trunk has a pair of pelvic fins and two dorsal fins.

8. The caudal fin is rounded.

9. Narcine has two large electric organs on the disc. They are kidney shape. Each electric organ is formed of muscle fibers arranged in blocks and serve as batteries.

10. Each organ is made up of a number of hexagonal celled eletroplexes, which represent the electric plates filled with jelly.

11. The dorsal surface of the electric plates is positive and the ventral surface is negative.

12. The electric current passes from dorsal to ventral surface. The electric organs are used for offense and defence.

Amphibian – Bufo

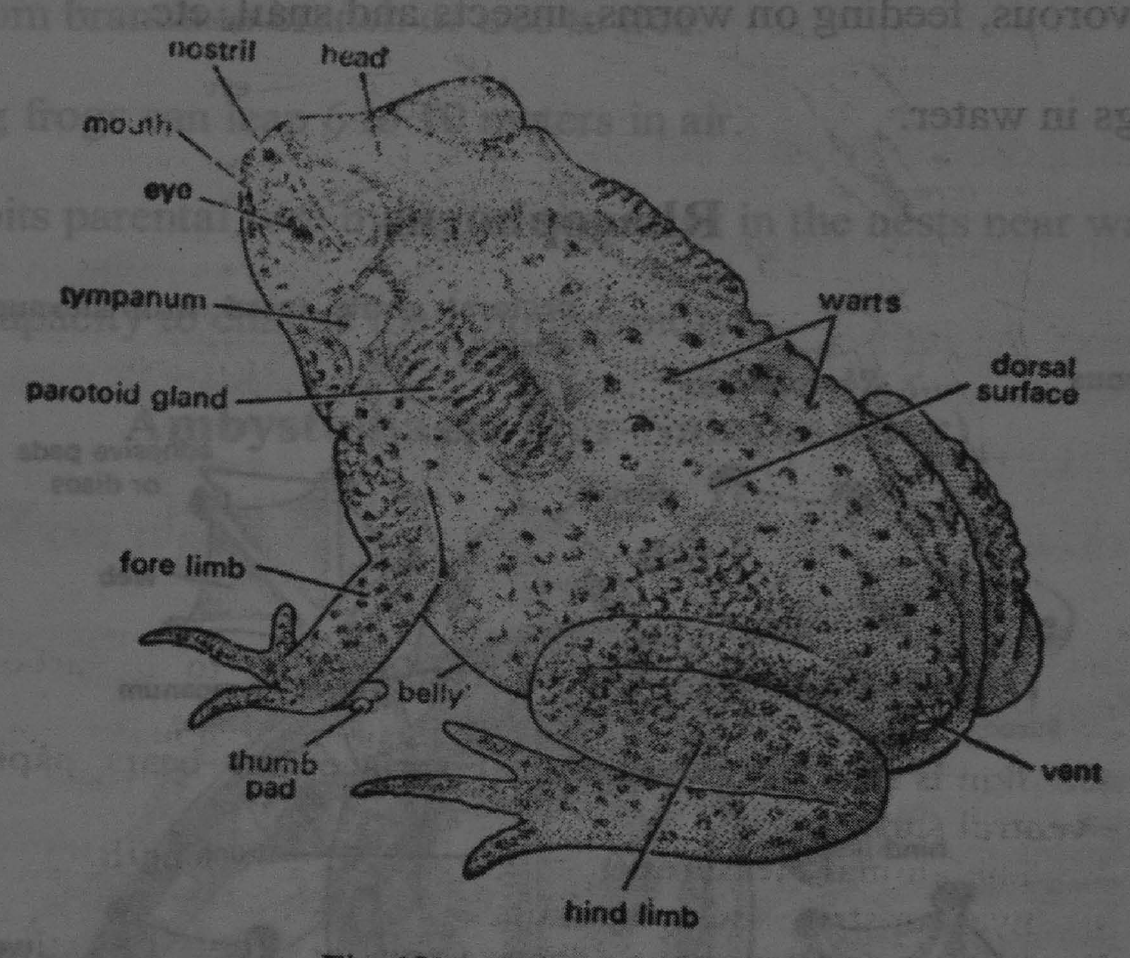


Fig. 150. *Bufo melanostictus.*

1. Bufo melanostictus is commonly called as true-toad.

2. It is an amphibian. It has no tail and hence it is included in the order Anura.

3. It is terrestrial. It lives most of the time on moist land.

4. It is nocturnal in habit.

5. The body consists of a head and a trunk.

6. The head consist of a mouth, a pair of small nostrils, a pair of large eyes and a pair of tympanum.

7. Tongue is round, teeth are entirely absent.

8. Skin is rough, dry and warts on the dorsal surface of the body.

9. A pair of parotid glands is present behind the tympanum. These glands secrete poison fluid, which is irritating.

10. Fore-limbs bear three web less fingers and a thumb pad.

11. Hind-limbs have three toes with a greatly reduced web.

12. The posterior side has a cloacal aperture.

13. It is carnivorous, feeding on worms, insects and snail, etc.

14. It lays eggs in water.

Rhacophorus

Genus ... *Rhacophorus*

pectoral girdle fused with sternum ; ribs absent.

Fig. 152 *Rhacophorus.*

1. Rhacophorus is commonly known as flying frog (tree frog).

2. It is an anuran amphibian.

3. The body is slender.

3. Head is broad and bearing eyes, nostrils and tympanum.

4. Limbs are penta-dactylous long and slender.

5. Both fingers and toes are webbed.

6. The fingers and toes are tipped with adhesive-pads or discs for sticking on the smooth surfachs. They are used for climbing trees, walls, etc.

7. It lives on trees. Usually large webbed feet are used as palms in gliding (like parachutes) from branch to branch or tree to tree.

8. These flying frogs can leap 6 to 10 meters in air.

9. It also exhibits parental care by depositing eggs in the nests near water.

10. It has the capacity to change the colour rapidly.

Ambystoma (Tiger-Salamander)

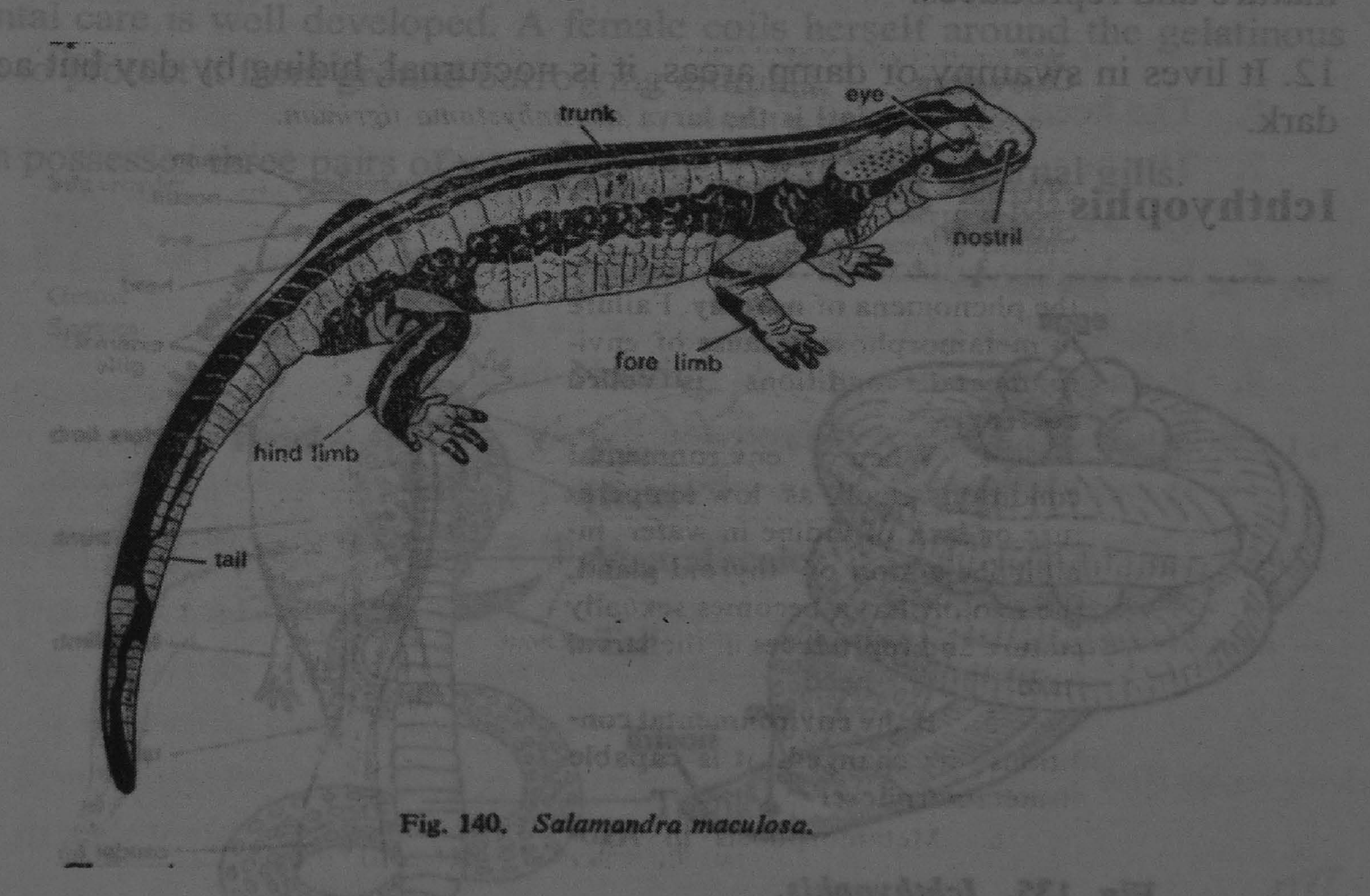


Fig. 140. *Salamandra maculosa.*

1. Asmbystoma trigrinum is commonly called as tiger-salamander or spotted salamander.

2. It is a urodele amphibian. It has a tail and hence it is included in the order Urodela.

3. Body is elongated lizard-like about 12 cm in length.

4. It is a terrestrial tailed amphibian.

5. The body consists of a head, a neck, a trunk and a tail.

6. The head contains a terminal mouth, a pair of nostrils and a pair of eyes. Eyelids are present.

7. A pair of parotid glands is present on the head. They secrete a poisonous fluid.

8. The trunk has a pair of fore limbs with 4 fingers and a pair of hind limbs with 5 toes.

9. The tail is composed without a tail fin.

10. The sexes are separate. Fertilization is internal.

11. Development is indirect. The larva is called Axolotl. The Axolotl larva exhibits neoteny. It develops sexual organs in the larval stage, becomes sexually mature and reproduces.

12. It lives in swampy or damp areas, it is nocturnal, hiding by day but active after dark.

Ichthyophis

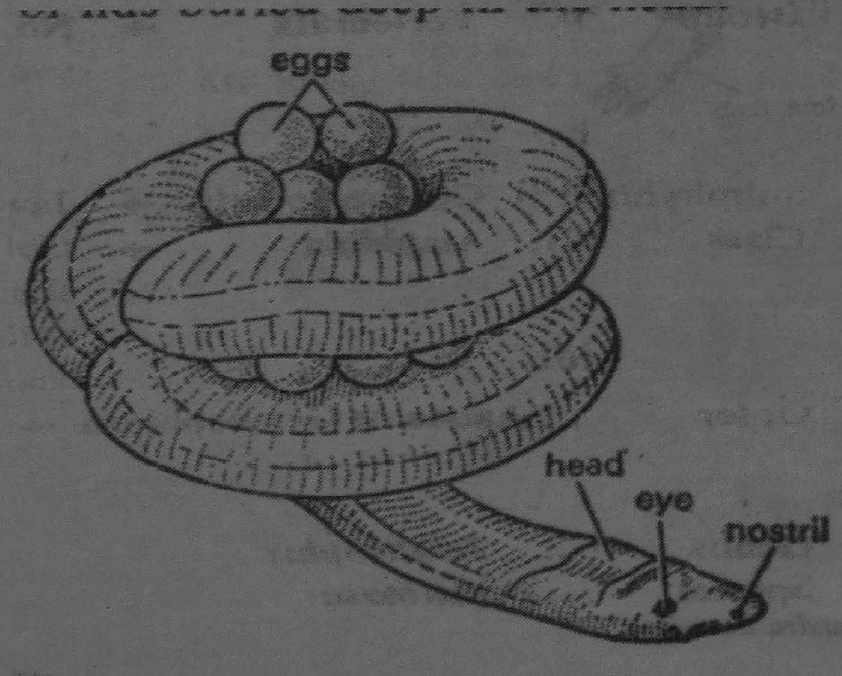


Fig. 135. *Ichthyophis.*

1. Ichthyophis is commonly called caecilian or blind worm.

2. It lives in moist places.

3. It is a burrowing, elongated eel-type animal.

4. The body is worm-like (35cm long) with 200 to 400 ring-like circular folds of slimy skin.

5. The colour of the body is dark brown or bluish black with a yellow band along the side.

6. The skin is wrinkled with minute scales.

7. Limbs and limb girdles are entirely absent.

8. The body consists of a head, a trunk and a short or vestigial tail.

9. The head has a mouth, a pair of nostrils and a pair of eyes and tentacular pits below the eyes.

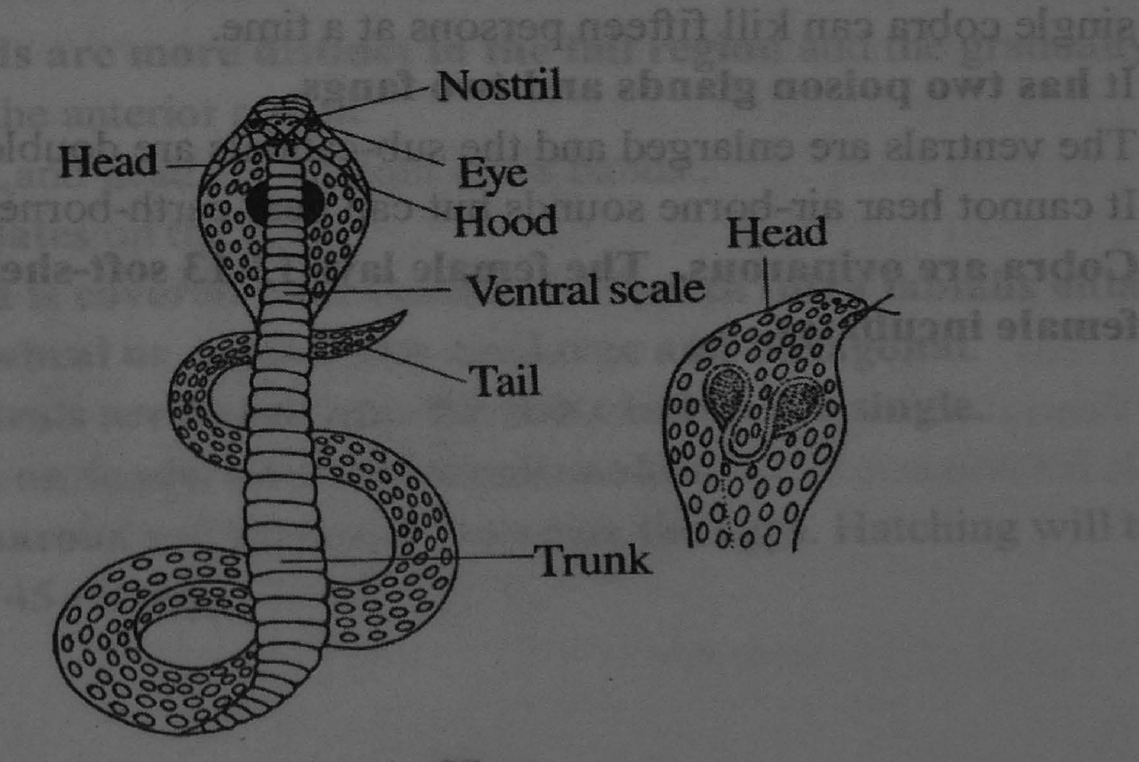
10. Tympanic membrane and columella are absent.

11. Sexes are separate, males possess large copulatory organ provided with hooks.

12. Parental care is well developed. A female coils herself around the gelatinous egg mass to protect it from ground burrowing animals.

13. Larva possesses three pairs of very long finely branched external gills.

Cobra



Classification

Phylum **:Chordata**

Subphylum : **Vertebrata**

Class **: Reptilia**

Order **: Diapsida**

Genus **: Naja**

Species **: naja**

Comments

1. It lives in burrows, deserted hills of termites, heaps of stones and stacks of woods.
2. It is brown or black in colour and grows to a length of 6 feet.
3. **It feeds on frogs, lizards, rats and small birds.**
4. When disturbed, **it raises its head and spreads its neck as a hood**. The hood is supported by cervical ribs. It sways its head and hood to the right and left, backwards and forwards, maka hissing sound in anger and gets ready to strike or bite.
5. The **hood has a characteristic spectacle mark** on the dorsal side and a pair of black patches on the ventral side.
6. The head is not distinct from the body.
7. The head is covered by shields. **The third supralabial shield touches the eye and the nostril.**
8. It is highly poisonous. **The poison is a neurotoxin.** The poison of a single cobra can kill fifteen persons at a time.
9. **It has two poison glands and two fangs.**
10. The ventrals are enlarged and the sub-caudals are double.
11. It cannot hear air-borne sounds but can hear earth-borne sounds.
12. **Cobra are oviparous. The female lays 12-13 soft-shelled eggs and the female incubates.**

Krait – (KattuVirian)

Classification

Phylum : Chordata

Sub phylum : Vertebrata

Class : Reptilia

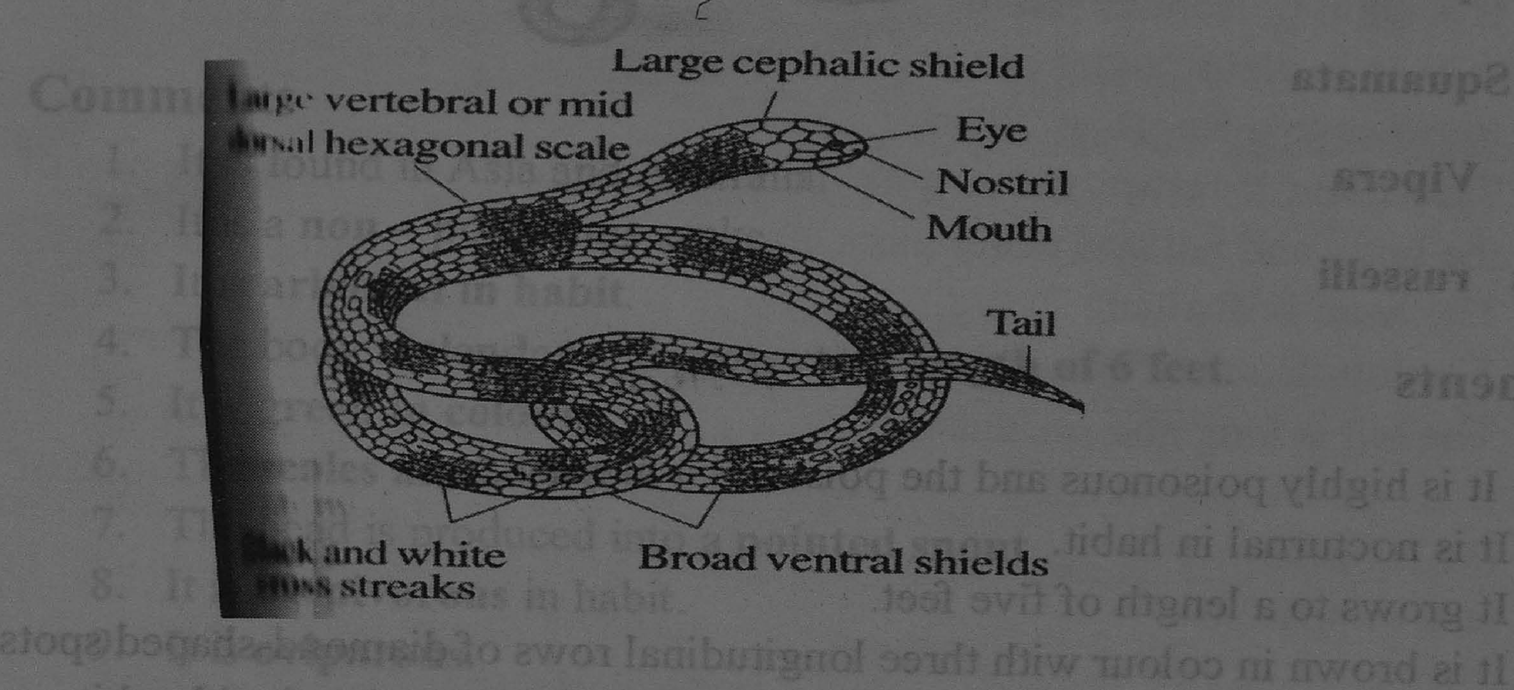
Order : Squamata

Genus : Bungarus

Species : fasciatus

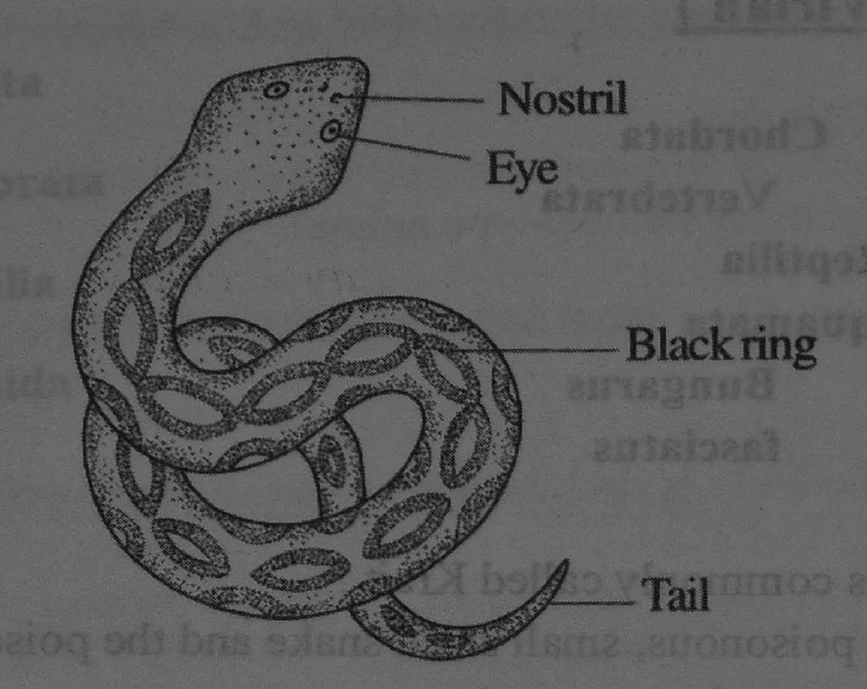
Comments

1. Bungarus is commonly called Krait .
2. It is highly poisonous, small sized snake and the poison is a **neurotoxin** affecting the **respiratory system** .
3. They **grow upto 120 cms** in length .
4. It is **nocturnal** in habit and very often comes near human dwellings.
5. The body is steel black incolour with thin white cross bands.



6. The **bands are more distinct in the tail region** and the gradually fade towards the anterior region.
7. The neck and head are without cross bands .
8. **Broad plates** on the body.
9. The **head is covered with shields**, the **fourth infra labialis enlarged** .
10. The **vertebral or** dorsal **scales are large and hexagonal.**
11. The **ventrals are broad and the sub caudals are single.**
12. It **feeds on toads, mice and small snakes.**
13. It is **oviparous** and the female incubate the eggs. Hatching will takes place in about 45-60 days.

Viper



Phylum Chordata

Subphylum Vertebrata

Class Reptilia

Order Squamata

Genus Vipera

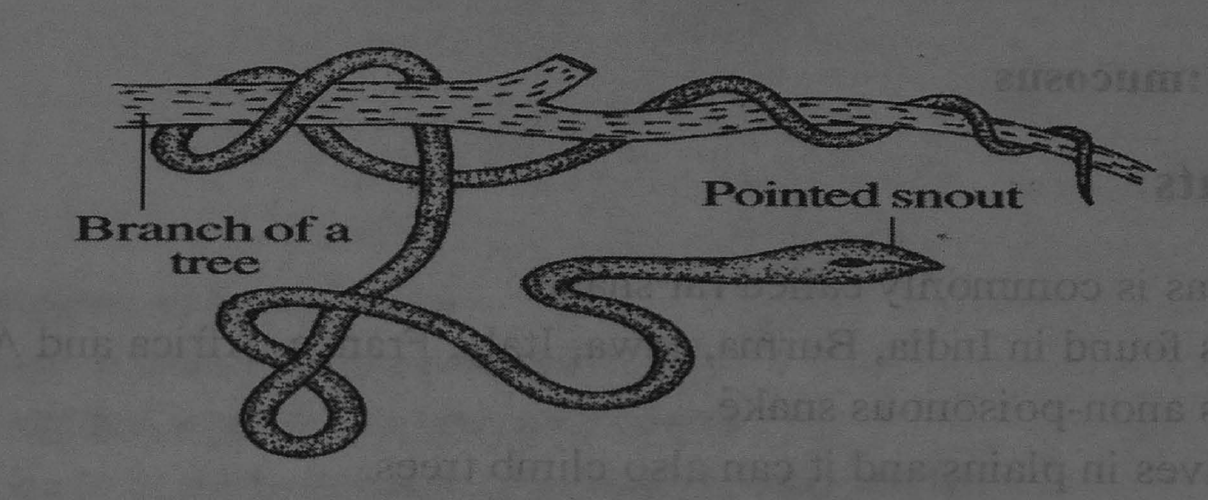
Species russelli

Comments

1. It is highly poisonous and the poison is a haemotoxin.
2. It is nocturnal in habit.
3. It grows to a length of five feet.
4. It is brown in colour with three longitudinal rows of diamond-shaped spots on the dorsal side. Each spot is black in colour and bordered with white. These give a beautiful look to the snake.
5. The head is distinct and is triangular In shape.
6. The head is covered with scales.
7. The head bears a distinct V-shaped mark with the point of V looking for wards.
8. Ventrals are broad.
9. It is viviparous giving birth to 30-40 young ones at a time.

Dryophis- Tree snake

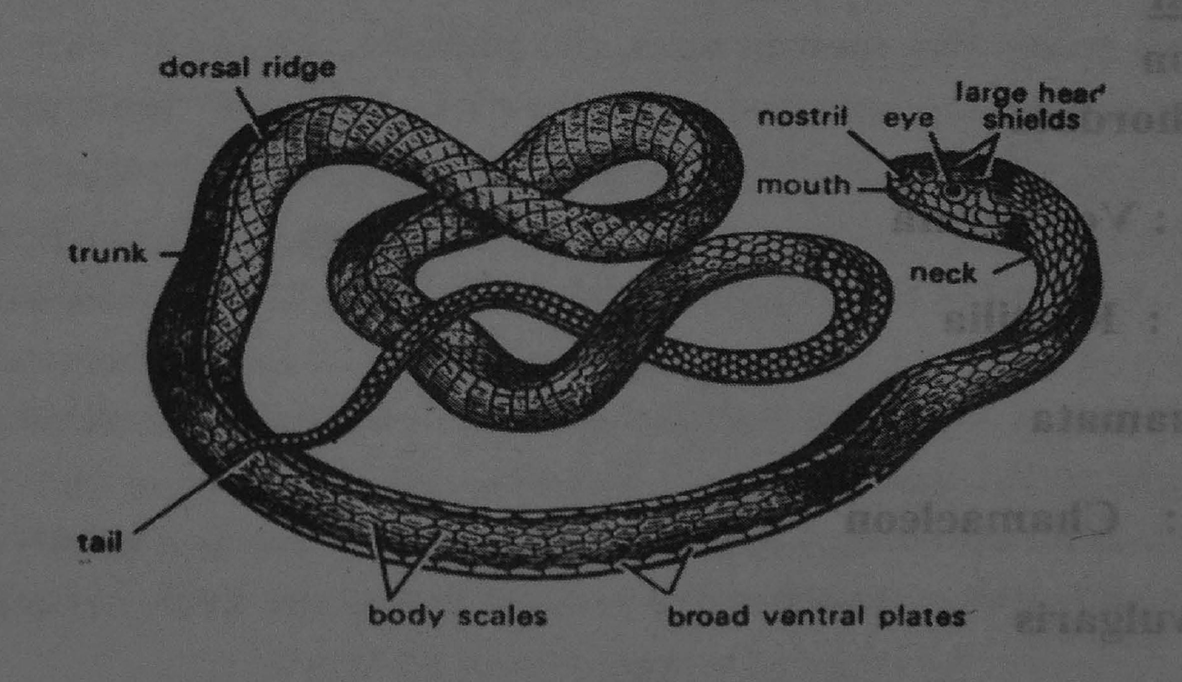
Phylum: Chordata
Sub phylum : Vertebrata
Class: Reptilia
Order :Squamata
Genus : Dryophis
Species : nasuta



Comments

1. It is found in Asia and Australia.
2. It is a **non – poisonous** snake.
3. It is **arboreal in habit**.
4. The body is **slender** and **grows to a length of 6 feet.**
5. It is **green in colour**.
6. The **scales are keeled.**
7. The head is produced into a **pointed snout** .
8. It is **carnivorous** in habit.
9. It is **oviparous**.

Ptyas



Phylum : Chordata

Subphylum : Vertebrata

Class : Reptilia

Order : Squamata

Genus : Zamenis

Species :mucosus

Comments

1. Ptyas is commonly called rat snake.
2. It is found in India, Burma, Jawa, Italy, France, Africa and America.
3. It is anon-poisonous snake.
4. It lives in plains and it can also climb trees.
5. It grows to a length of 7 feet.
6. The colour is brown above with black cross bands on the posterior part of the body and tail and under parts are yellowish.
7. The head is distinct.
8. The fourth and fifth supra labials touch the eye.
9. The tail is long and prehensile.
10. It is carnivorous in habit. It feeds on rats and considered to be a friend of the farmers.
11. It is viviparous.

Chameleon

Classification

Phylum :Chordata

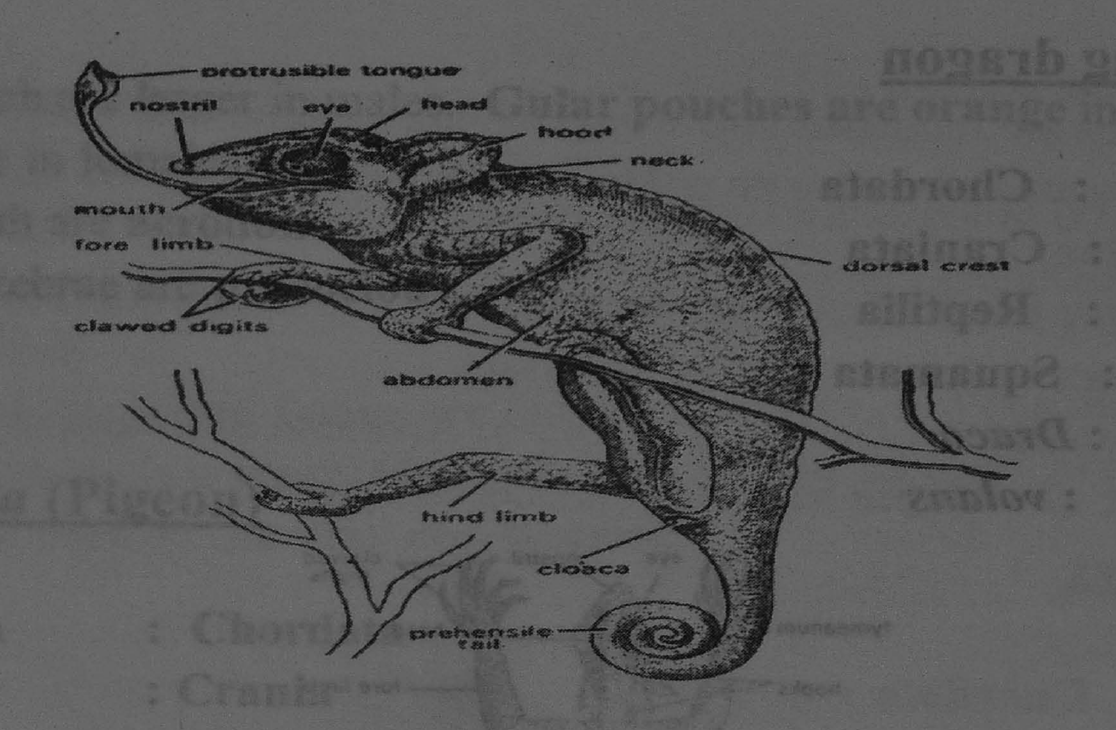
Subphylum : Vertebrata

Class : Reptilia

Order: Squamata

Genus : Chamaeleon

'pecies : vulgaris



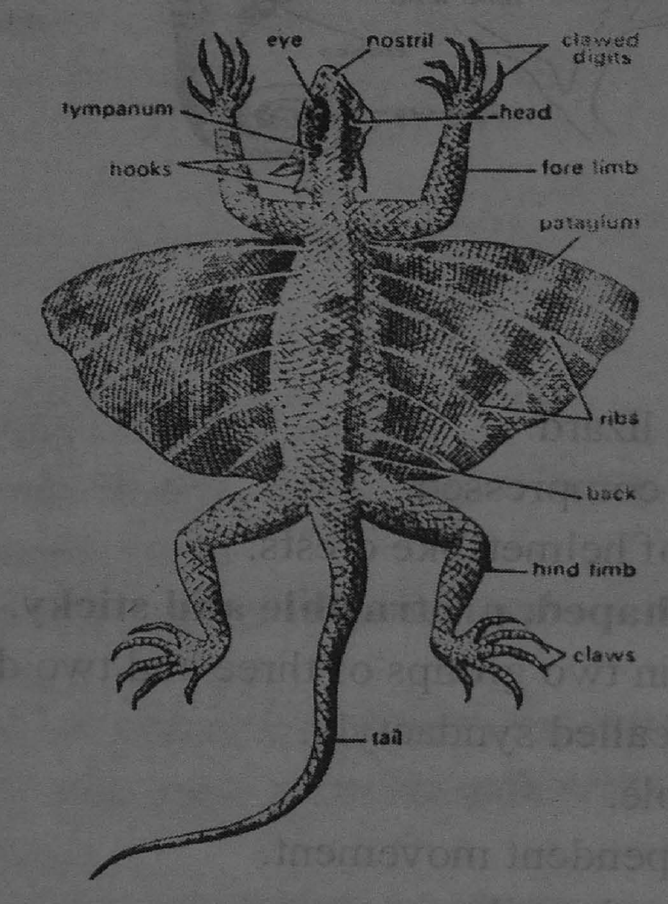
Comments

1. Chamaeleon is a tree lizard.
2. The body is laterally compressed.
3. The head has a pair of helmet-like crests.
4. The tongue is **club-shaped, protrusible and sticky**.
5. The digits are fused in two groups of three and two digits. The fusion of digits into groups is called syndactyly.
6. The toes are opposable.
7. The eyes show independent movement.
8. The tail is long and prehensile.
9. The lungs are provided with air sacs.
10. It has **the power of changing its colour** very often.
11. It can **produce hissing sound** and it can swell its body when it is approached by an enemy.
12. **It is an insectivorous animal.**

Draco - Flying dragon

Classification

Phylum : Chordata
Group : Craniata
Class : Reptilia
Order : Squamata
Genus : ***Draco***
Species : ***volans***



Comments

1. Draco is commonly known as **flying-dragon or flying lizard**.
2. It is **arboreal**,living on trees and **feed upon small insects.**
3. Body is dorso-ventrally compressed and measuring about 25cm in length. Body is divided into head, neck, trunk and long, pointed tail.
4. The sides of the body between the fore and hindlimbs, extend as a pair of large **wing-like membranes,** the **patagia**, which are supported by five or six much elongated posterior ribs. These are **used as parachutesduring flight**. These wing-like membranes can be folded up like a fan.
5. Head bears wide mouth, eyes with eyelids, nostrils and openings of external ear.
6. On the throat are **three pointed hooks,** a short one on either side and a long one in the middle.
7. **Sexual dimorphism** exists. Male has a small **nuchal crest,** Distensible **gular pouches** are present below the neck in both sexes,

which are larger in males. **Gular pouches are orange** in males and **blue** in females.

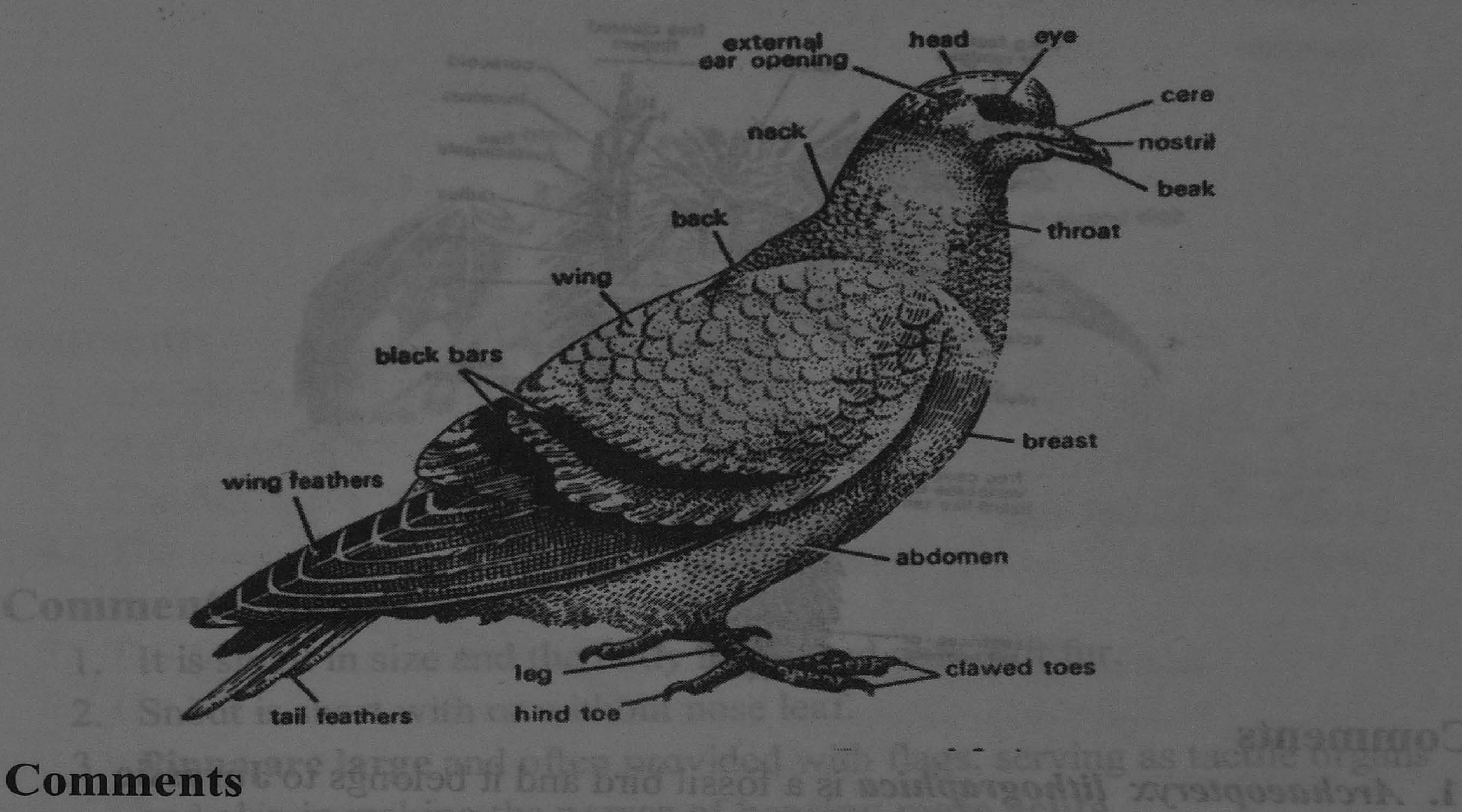
8. Teeth are **acrodont**.
9. Vertebrae are **procoelous.**

Birds

Columba livia (Pigeon)

Classification

Phylum	**: Chordata**
Group	**: Crania**
Class	**: Aves**
Order	**: Columbiformes**
Genus	**: *Columba***
Species	**:*livia***



Comments

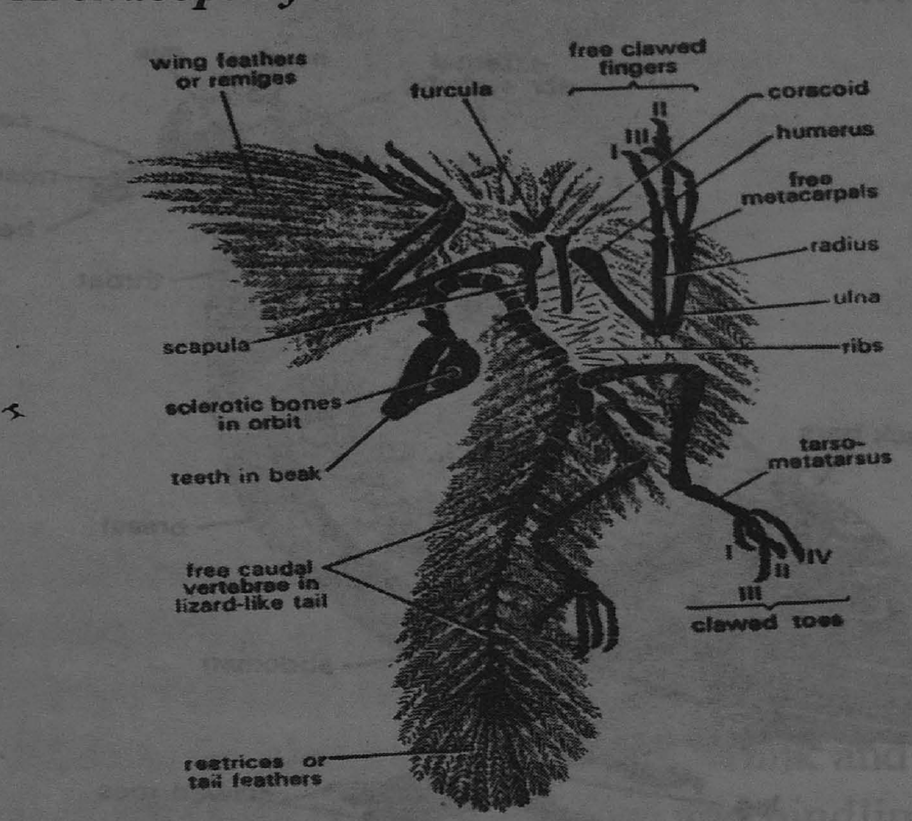
1. ***Columba livia*** is commonly known as **Blue-rock-pigeon.**
2. It is familiar slaty-grey bird with glistening metallic green, purple and magenta seen on the neck and upper breast. Two dark bars on wings and a band across the end of the tail are also present.
3. It measures about 34cm or more in length. Both the sexes are alike.
4. Head bears large **eyes with nictitating membrane,** slit-like nostrils at the base of short and slender beak and ear openings.

5. Forelimbs are modified into **wings** having skeleton and feathers and hindlimbs are covered with epidermal scales and **adapted for bipedal locomotion.**
6. Pigeons are domesticated for amusement. In olden times they were used as messengers for carrying informations.
7. It is an example of Darwin's Theory of Artificial Selection of Evolution as a number of varieties have been produced by man.

Archaeopteryx

Classification

Phylum	:	**Chordata**
Group	:	**Craniata**
Class	:	**Aves**
Order	:	**Ciconiiformes**
Genus	:	***Archaeopteryx***



Comments

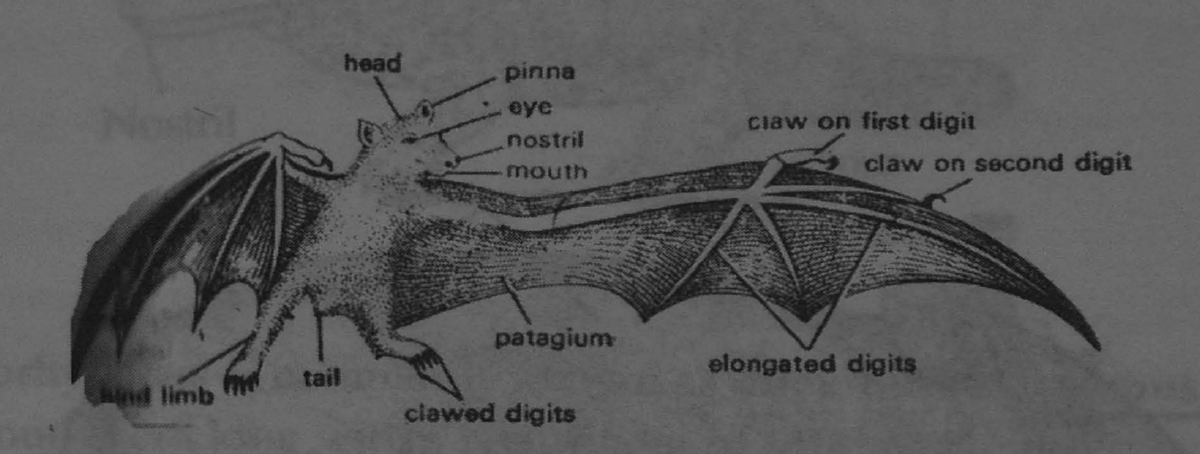
1. ***Archaeopteryx lithographica*** is a fossil bird and it belongs to **Jurassic period.**
1. Body was divisible into head, neck, breast, abdomen and elongated tail with **rectrices.**
2. Head was provided with eyes, nostrils, ear openings and long beak. **Jaws were teethed**like lizards.
3. Body was covered with scales. But forelimbs were modified into wings with remiges.
4. **Legs were scaly and toes clawed** one behind and three anterior.
5. **Archaeopteryx** had both **reptilian and avian features.**

6. **The cerebral hemispheres were smooth, long and narrow and cerebellum was small, thus the brain is reptilian.**
7. Archaeopteryx could not fly efficiently because the sternum is small, flat and without a keel, the wing spread is small, and it has an elongated, feathered, lizard-like tail.
8. **The skull is large and bones are fused as in birds, but the fontals are small and there is a short, blunt beak and flight feathers are attached only to the back of the ulna and manus.**

Bat

Classification

Phylum	:	**Chordata**
Group	:	**Vertebrata**
Class	:	**Mammalia**
Order	:	**Chiroptera**



Comments

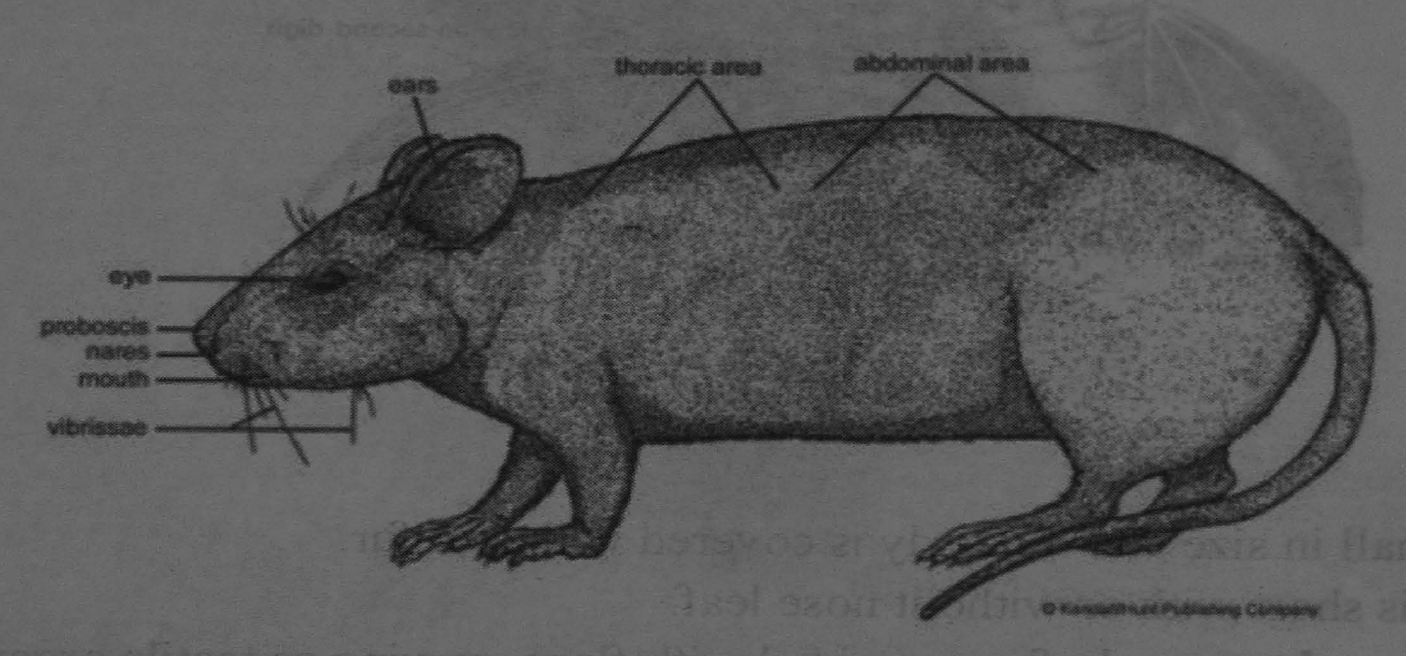
1. It is small in size and the body is covered with soft fur.
2. Snout is short with or without nose leaf.
3. **Pinna are large** and often provided with flags, serving as tactile organs and also in making the **power of hearing more acute**.
4. **Eyes are small and the vision is weak** as the visual rods are poorly developed.
5. Tail is included in the **inter-femoral membrane** provided with a distinct flap.
6. Only the thumb or **first digit is clawed** in the fore limbs.
7. Hind-limbs are weak and have five clawed digits.
8. Molars have cusped crowns with transverse grooves.

9. **Nocturnal** in habit. During the day they spend their time sleeping in caves or other dark sheltered places and come out at dusk for feeding.
10. **Insectivorous**, through occasionally **frugivorous** or **sanguivorous** (blood sucking).
11. **Gregarious -** living in colonies of thousands.
12. They **produce ultra-sonic sound waves** which after striking on the solid objects are reflected back and are picked up by their ears; guiding in their flight.

Rat

Classification:

Phylum : **Chordata**
Group : **Vertebrata**
Class: **Mammalia**
Order : **Rodentia**
Genus : ***Rattus***
Species :***rattus***



Comments

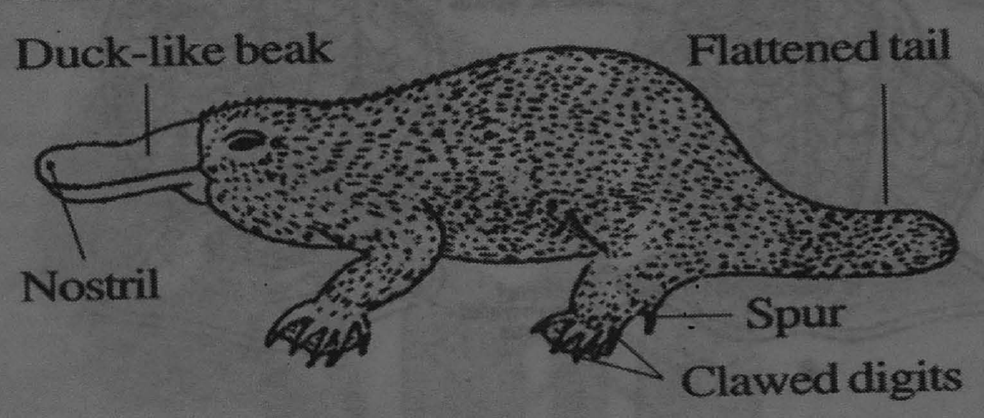
1. ***Rattusrattus*** is commonly called **common rat.**
2. The body of rat is slender with thick-set fine fur mixed with stiff hairs.
3. It is usually grayish or brownish in colour.
4. Body is divisible into four distinct regions: Head, neck, trunk and tail.
5. Head is elongated somewhat conical in shape and tapering anteriorly to a terminal nose.
6. Neck is a short region joining the head to the trunk.
7. Trunk is the largest part of the body.

8. Tail is elongated, cylindrical and tapering and often slightly longer than body.
9. **Viviparous.**
10. Rat also act as a **carrier of diseases like plague and typhus fever.**
11. Rat is chiefly **nocturnal** in habit and thrives best in warm climate. It inhabits hole and burrows in the houses and cultivated fields.

Ornithorhynchus (Platypus)

Classification

Phylum : **Chordata**
Group : **Vertebrata**
Class : **Mammalia**
Order : **Monotremata**
Genus : ***Ornithorhynchus***
Species : ***anatinus***



Comments

1. Ornithorhynchus is commonly known as **duck-billed platypus.**
2. It is about 45cm long with a heavy coat of soft brown fur.
3. The **limbs are short and five toed**, the toes being **webbed and clawed**.
4. The webbing of the forelimbs extending well beyond the tips of toes but the hind limbs are not webbed to that extent.
5. The **tail is large and broad** being **dorso-ventrally flattened**.
6. The bill or beak is broad and flat and is covered with fine soft, sensitive naked skin having tactile sensory organs.
7. The **teeth are absent in the adult** but broad **horny plates** are present lining inside of the bill.
8. **Eyes are small** and bead-like.
9. External ear-lobe or **pinna is absent**.
10. The **male has a spur on the heel.**
11. It is **carnivorous**. Food chiefly comprises molluscan shells, crustaceans and worms.

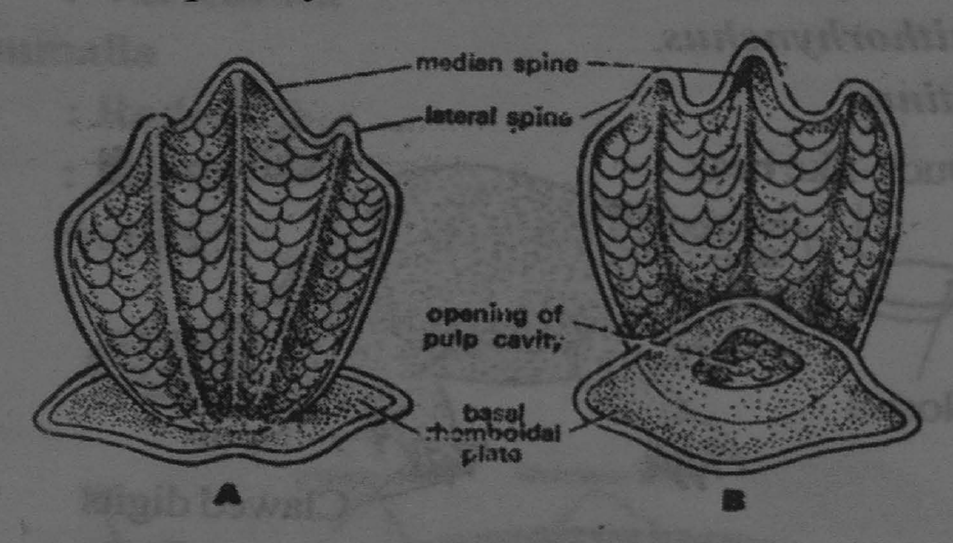
12. Ornithorhynchus is **aquatic in habit** and **lives in burrows** on the banks of rivers and streams.

Mountings

1. Placoid Scales of ***Scoliodon***

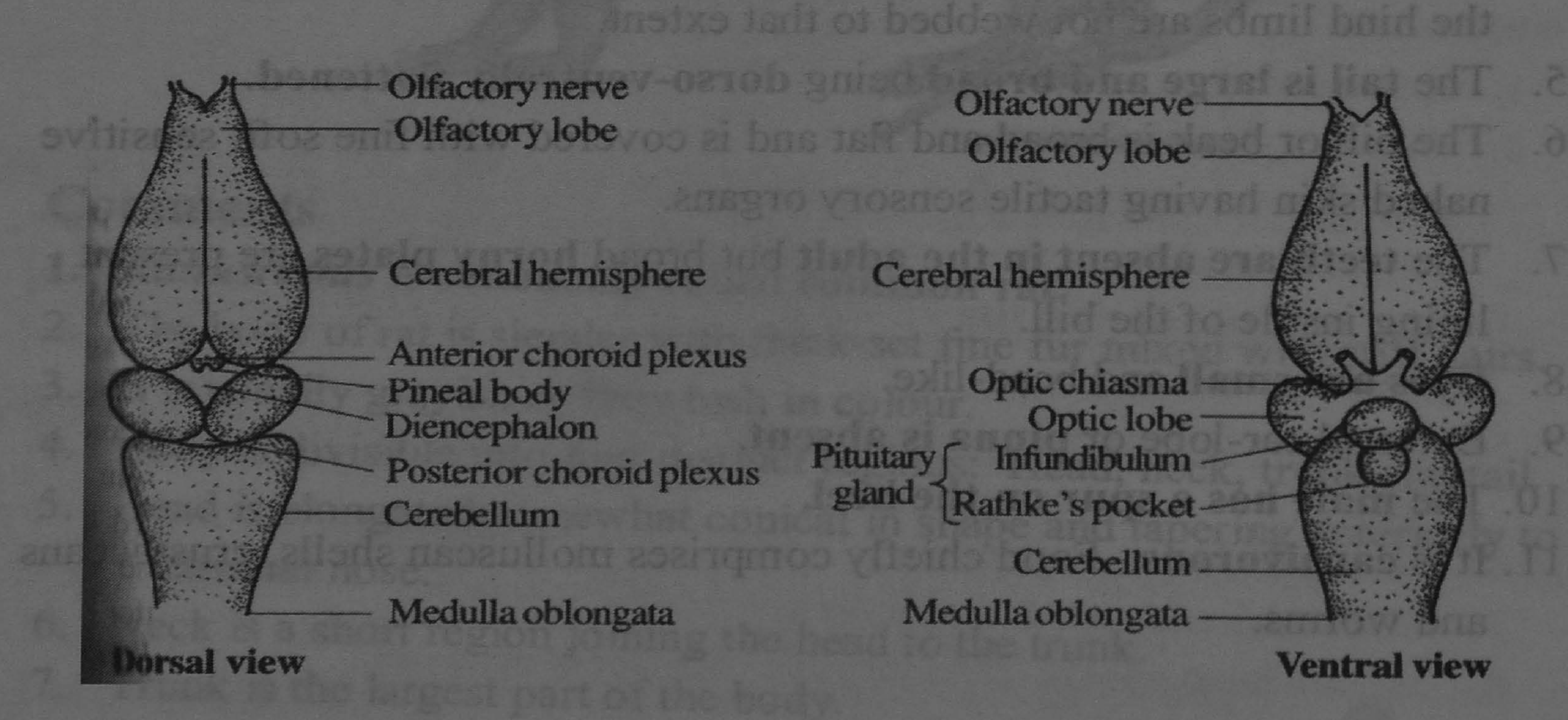
Procedure

Cut a small piece of skin from the dorsal surface of***Scoliodon*** and remove all the muscles from its ventral surface. Boil it in 5% solution of KOH in a test tube until a brown residue settles at the bottom of the test tube. The brown residue is nothing but the placoid scales which have been detached from the skin during boiling. Let the residue settle down on the bottom of the test tube and remove the KOH solution slowly. Now thoroughly wash the placoid scales in water 4 or 5 times so that KOH is completely removed from them.

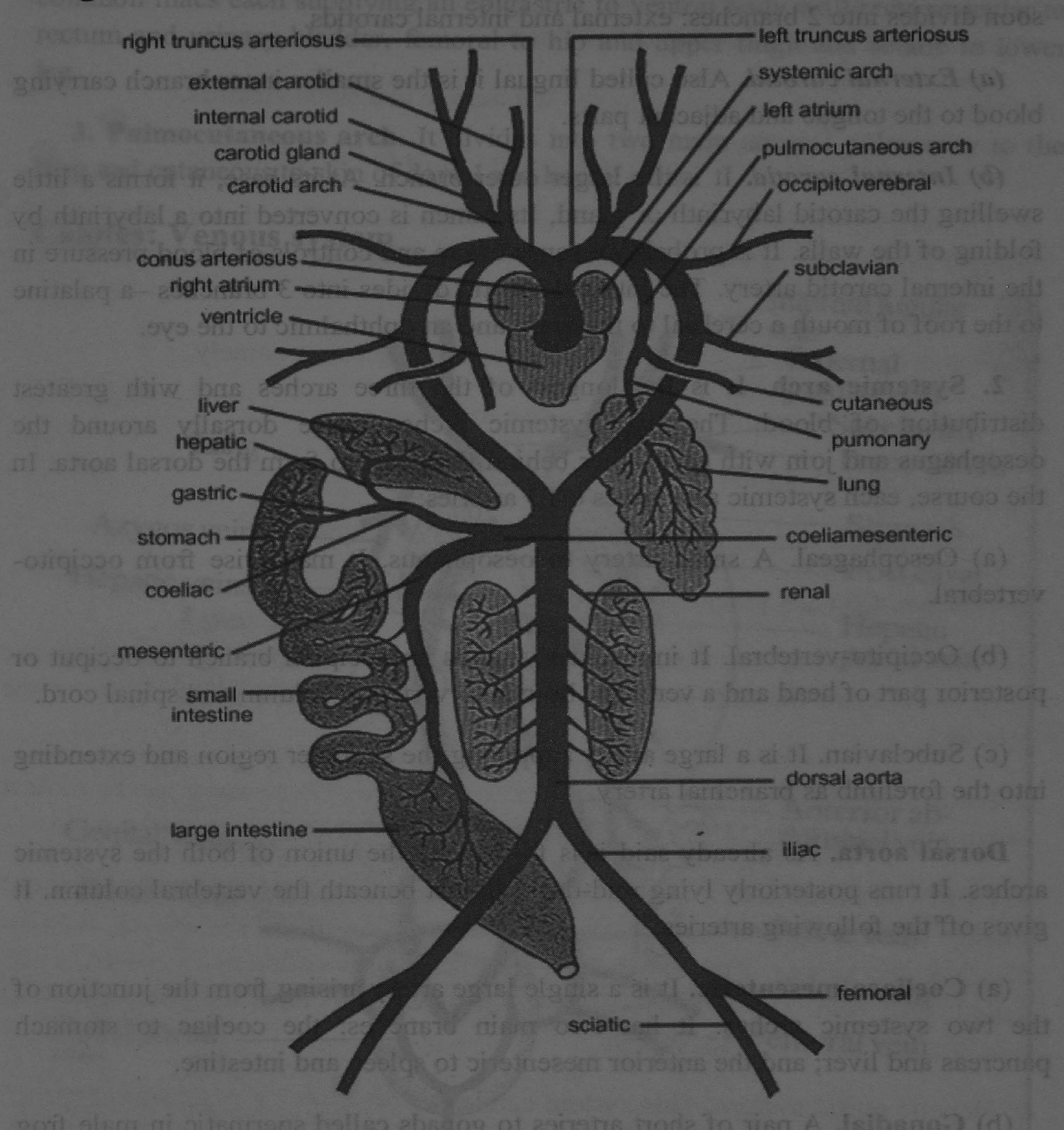


Proceed for dehydration upto 70% alcohol, stainin borax, caramine or picro-indigo carmine, again dehydrate upto absolute alcohol, clear in xylol or clove oil and finally mount in **Canada balsam**.

1. Frog Brain



Frog- Arterial system



1. Aortic arches. Arteries carry blood away from the heart. The arterial system in frog begins with the truncus arteriosus.

2. As already mentioned, the truncus divides into left and right branches or trunks, each of which subdivides into three major vessels or aortic arches: (1) Common carotid to head, (2) systematic to body and vice versa and (3) pulmocutaneous to lung and skin.

1. Common carotid arch. It is short vessel running forward and outward, but soon divides into 2 branches: external and internal carotids.

(a) External carotid. Also called lingual it is the smaller inner branch carrying blood to the tongue and adjacent parts.

(b) Internal carotid. It is the larger outer branch. At its base, it forms a little swelling the carotid labyrinth or gland, Its lumen is converted into a labyrinth by folding of the walls. It is probably a sense organ and controls of blood pressure in the internal carotid artery. The internal carotid divides into 3 branches –a palatine to the roof of mouth a cerebral to the brain and an ophthalmic to the eye.

2. Systemic arch. It is the longest of the three arches and with greatest distribution of blood. The two systemic arches curve dorsally around the oesophagus and join with each other behind the heart to form the dorsal aorta. In the course, each systemic arch gives off 3 arteries:

(a) Oesophageal. A small artery to oesophagus. It may arise from occipito-vertebral.

(b) Occipito-vertebral. It immediately sends an occipital branch to occiput or posterior part of head and a vertebral branch to vertebral column and spinal cord.

(c) Subclavian. It is a large artery supplying the shoulder region and extending into the forelimb as branchial artery.

Dorsal aorta. As already said it is formed by the union of both the systemic arches. It runs posteriorly lying mid-dorsally just beneath the vertebral column. It gives off the following arteries:

(a) **Coeliaco-mesenteric.** It is a single large artery arising from the junction of the two systemic arches. It has two main branches: the coeliac to stomach pancreas and liver; and the anterior mesenteric to spleen and intestine.

(b) **Gonadial.** A pair of short arteries to gonads called spermatic in male frog and ovarian in female frog.

(c) **Renal.** While passing between the two kidneys dorsal aorta sends off 5-6 pairs of small renal arteries in a series into both the kidneys.

(d) **Posterior mensenteric.** It arises from the posterior end of dorsal aorta of sometimes from anterior mensenteric. It goes to large intestine or rectum.

(e) **Common iliacs.** The dorsal aorta finally bifurcates posteriorly into two common iliacs each supplying an epigastric to ventral body wall rectovesicular to rectum and urinary bladder, femoral to hip and upper thigh and sciatic to lower leg.

3. Pulmocutaneous arch. It divides into two main arteries pulmonary to the lung and cutaneous to skin of dorsal and lateral sides.

Calotes: Venous system

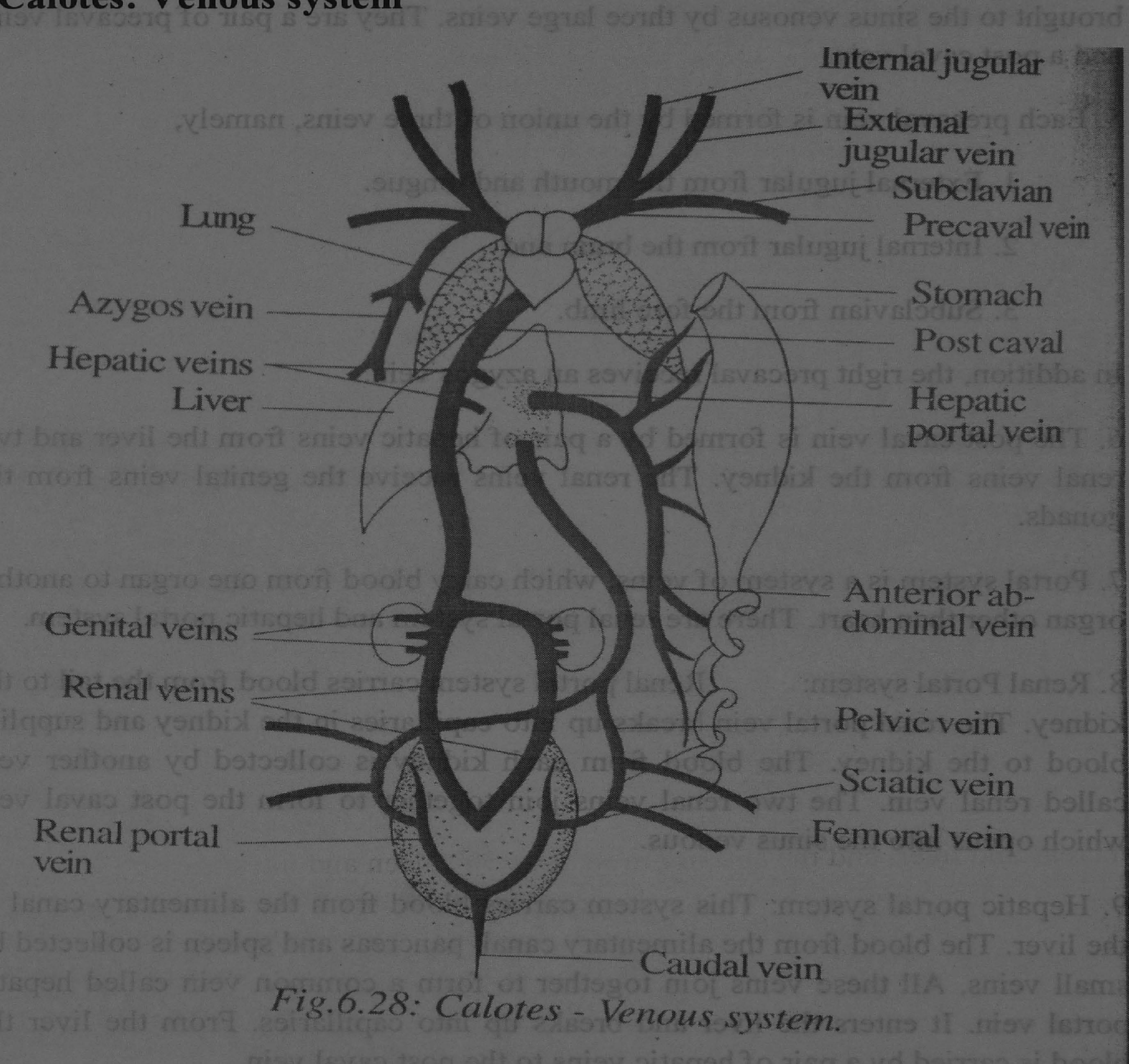


Fig.6.28: Calotes - Venous system.

1. It is a system of blood vessels, which carry blood from various parts of the body to the heart. These blood vessels are called veins. All the veins, except the pulmonary vein, carry deoxygenated blood.

2. The venous blood is received by the left auricle and sinus venosus.

3. The pulmonary veins bring blood from the lungs to the left auricle.

4. The venous blood is received by the sinus venosus of the heart. The blood is brought to the sinus venosus by three large veins. They are a pair of precaval veins and a post caval vein.

5. Each precaval vein is formed by the union of three veins, namely,

   1. External jugular from the mouth and tongue.

   2. Internal jugular from the brain and

   3. Subclavian from the fore limb.

In addition, the right precaval receives an azygos vein.

6. The post caval vein is formed by a pair of hepatic veins from the liver and two renal veins from the kidney. The renal veins receive the genital veins from the gonads.

7. Portal system is a system of veins, which carry blood from one organ to another organ other than heart. There are renal portal system and hepatic portal system.

8. Renal Portal system: Renal portal system carries blood from the tail to the kidney. The renal portal vein breaks up into capillaries in the kidney and supplies blood to the kidney. The blood from each kidney is collected by another vein called renal vein. The two renal veins join together to form the post caval vein which opens into the sinus venous.

9. Hepatic portal system: This system carries blood from the alimentary canal to the liver. The blood from the alimentary canal, pancreas and spleen is collected by small veins. All these veins join together to form a common vein called hepatic portal vein. It enters the liver and breaks up into capillaries. From the liver the blood is carried by a pair of hepatic veins to the post caval vein.

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